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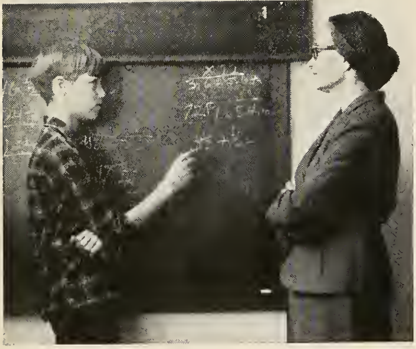

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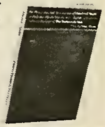

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Natural History

COVER: Recorded here by Napoleon A. Chagnon is the chest-pounding duel, way of adjudicating grievances among the chronically violent Yanomamö Indian of southern Venezuela. The antagonists take turns delivering the hardest blow they can. Anthropologist Chagnon explains in his article (*page 22*) that Yanomamö practice a "graded form of violence"—a formal type of escalation. Ches pounding is more brutal than side slapping but much less so than the reveng raid or the "trick" (an ambush). While living with the jungle people, Chagno met photographer Karl Weidmann, who helped with illustrating this article

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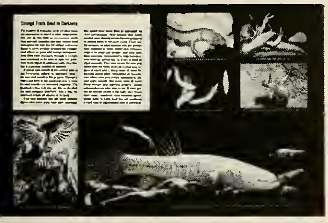

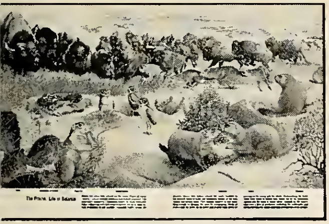

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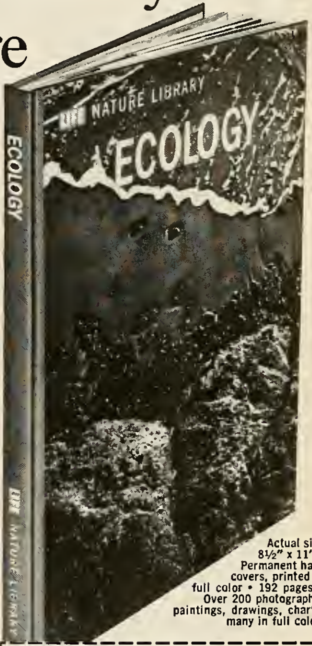

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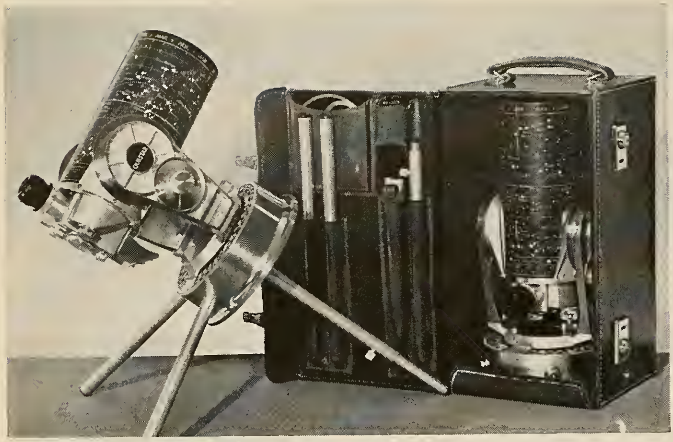

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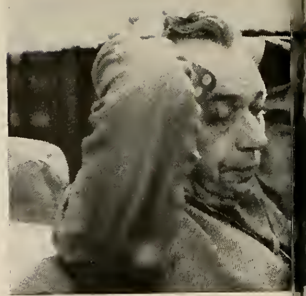

Marston Bates

ABOU

John Moser

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diseases such as malaria and yello
fever led to several well-know
books, including *The Natural Hi*
tory of Mosquitoes and *The Fore*
and the Sea.

NAPOLEON A. CHAGNON spe
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their demography, kinship, soci
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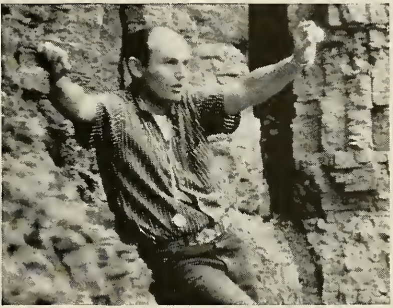
THE AUTHORS

David Dineley



Christopher Schuberth

and where he has been a teaching ellow. He will continue to study South American Indians, specifi- ally the Yanomamö who he feels re "the most significant remaining arge populations of undisturbed American Indians in either conti- nent."

JOHN C. MOSER is seen above with a clay model of an ant nest sed in the study on which his ar- icle, "Trails of the Leafcutters," is based. His finger touches a scaled epresentation of a cavity that was ctually large enough for him to rawl into. Dr. Moser is a research ntomologist for the Forest Insect Research Project of the U.S. Forest ervice in Alexandria, Louisiana. He received a doctorate in insect cology from Cornell University nd is the author of numerous papers.

DAVID L. DINELEY, author of "Ancient Fishes of Escuminac Bay," is Chairman of the Geology Department of the University of Ottawa and has done extensive work on the rocks and fossils of Devonian times. Born in England, Dr. Dineley received his Ph.D. in geology from the University of Birmingham. He has written more than thirty articles for scientific journals in Europe and North America and has recently returned from a field session on Somerset Island, Northwest Territories, where he studied fossil fish hitherto unknown in the Canadian north. His particular interest is Arctic geology, geography, and wildlife.

CHRISTOPHER J. SCHUBERTH is a senior instructor in the Department of Education at The American Museum of Natural History and is on the geology faculty at Hunter College and Fairleigh Dickinson University. Author of "The Hudson's Six Geologies," he has done extensive field research in New York and New Jersey. He also conducted a four-year field study near The American Museum's Southwestern Research Station in Arizona. Mr. Schuberth, who holds an M.S. in geology from New York University, is presently working on three books on geology to be published by the Natural History Press.

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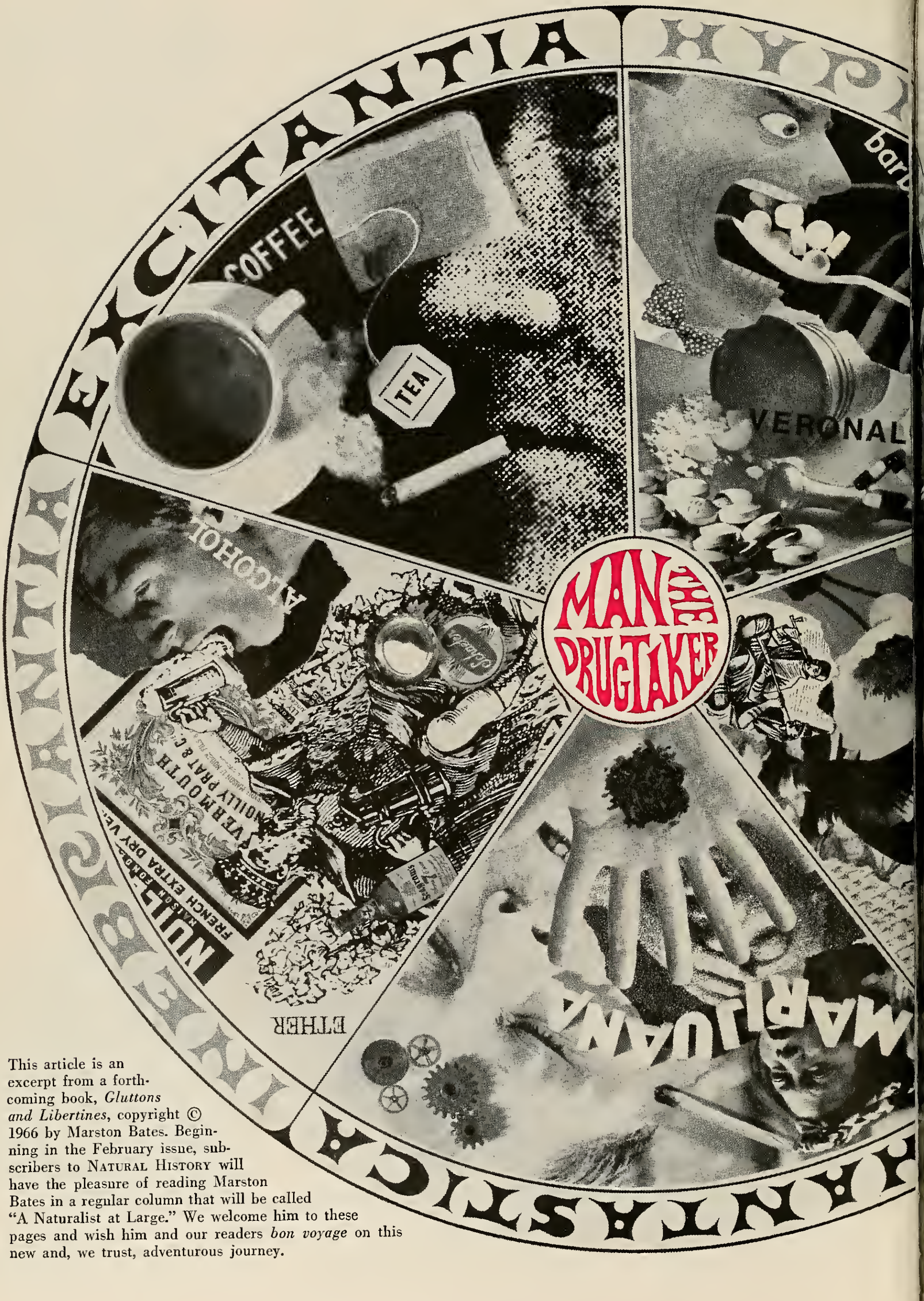
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This article is an excerpt from a forthcoming book, *Gluttons and Libertines*, copyright © 1966 by Marston Bates. Beginning in the February issue, subscribers to NATURAL HISTORY will have the pleasure of reading Marston Bates in a regular column that will be called "A Naturalist at Large." We welcome him to these pages and wish him and our readers *bon voyage* on this new and, we trust, adventurous journey.

"The desire to take medicine is perhaps the greatest feature which distinguishes man from animals."
WILLIAM OSLER

By MARSTON BATES

Along with his continuous nonperiodic sexuality, his addiction to internecine strife, and his use of weapons, tools, symbols, and fire, man has the habit of resorting to medicine. Man the drug taker—*Homo medicans.*

A drug, in the widest and most proper sense, is any substance used in medicine. But the word also has a narrow and special meaning that covers substances presumed to be habit forming and harmful. We have drug as in drugstore, and drug as in drug addict—which is confusing. There is further confusion in that we seem to have no clear basis for determining which substances are drugs in the bad sense, except that they are substances socially disapproved of in our present culture. Cigarettes made from tobacco are currently not classified as a drug, but cigarettes made from marijuana are. Yet all the evidence suggests that tobacco is both more habit forming and more unhealthy than the product of the hemp plant. Marijuana, to be sure, has a more dramatic effect than tobacco. In this respect it is comparable to alcohol, which, whatever our attitude toward it, is not ordinarily thought of as a drug.

There is also a nice problem of distinction between materials taken to cure or alleviate some disease—medicines—and materials taken for kicks. Alcohol, again, may be a valuable medicine in many situations, but it is not ordinarily thought of as medicinal when taken at a cocktail party. And then there are all the tranquilizers and stimulants that are prescribed by physicians as medicine but that have been taken up by the American public as avidly as have cigarettes and alcohol.

I suppose we could use the word "drug" to cover all materials taken for other than nutritional reasons, or we could expand the meaning of "medicine" to include materials taken for ills of the spirit as well as for ills of the flesh. Osler's dictum then becomes more meaningful. The variety of materials eaten, drunk, smoked, chewed, rubbed on the skin, or otherwise used for nonnutritional purposes by different peoples is extraordinary. Every known culture has a system of medicine that includes the use of animal and plant products. Even the Australian aborigines, generally considered to have the simplest of technical cultures, have a considerable pharmacopoeia, which includes items such as the inner bark of eucalyptus for congestion, pollen from bee nests for constipation, and mu-tir tree leaves for headache.

The dope-taking habit of man is so universal that it must have a long history, but since drugs rarely leave fossils we cannot be sure when it started, let alone how. When I try to think of anything comparable in other animals, I am driven back to the addiction of cats to catnip or of sick puppies to eating grass, which are pretty feeble precedents. Maybe animals coming to salt licks would be a better parallel, except that salt has nutritional value. I can recall nothing comparable with medicine taking among wild primates.

My guess would be that the use of non-nutritional materials by man goes back at least to the time when fire was first tamed, and the use of drugs may at first have been purely magical, as I think was the case with fire. However he got started, primitive man in the long run did a thorough job of ransacking the plant and animal kingdoms for materials that were useful or that were thought to be so. And we are discovering that many items in the primitive pharmacopoeia really were useful. Civilized man hardly added anything to the list until the modern development of the chemical industry and the systematic testing of drugs on animals. Even now, our debt to the past is tremendous. We have aspirin, that most useful and mysterious of drugs, because of a prehistoric discovery of the effectiveness of willow bark in treating rheumatism. Most recently, the whole array of tranquilizers comes from the discovery of the chemical nature of the juice of *Rauwolfia*, a plant common in the pharmacopoeia of India.

I wonder again whether our ancestors tried out natural products so extensively that there is nothing left for modern science to discover. Or whether chemistry and medicine have become so insulated in the urban environment of the modern world as to have no interest in continuing the exploration of nature.

But my interest here is not so much in drugs taken as medicine to cure physical disease as it is in drugs used as "shortcuts to happiness"—drugs that dull the hard edges of reality, that produce excitement and heightened perception, or that lead the taker into a

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dream world where all is beauty and peace. These are the substances, in other words, that modify our mental state in ways that we find pleasurable or desirable. Curiously, we have no general word for these substances. In our culture they are generally assumed to be bad—an aspect, I presume, of the same puritanical streak that makes sex dirty. The habit-forming and physiologically harmful drugs are sometimes classed as narcotics. But the dictionary defines a "narcotic" as a substance capable of producing a deep unconsciousness, which is true of only some of them. And some so-called drugs are neither habit forming nor demonstrably harmful. We need a word that will cover everything from opium to tea. The best I can do is to call them all the pleasure-giving drugs—those taken for kicks—although many of them, in their primitive context, were serious enough, being connected with religious or magical operations.

The list of drug types is a long one, and the naturally occurring substances were all discovered by our prehistoric ancestors. The great German toxicologist Louis Lewin classified them into five groups, and his classification is still commonly used by pharmacologists.

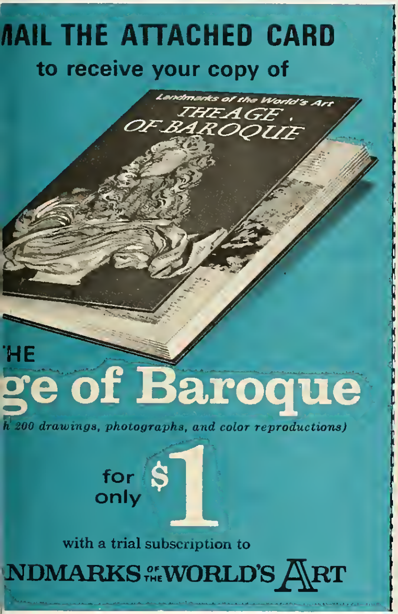
I. Euphorica: Sedatives of mental activity, inducing in the person taking them a state of physical and mental comfort. Here belong opium (and its components, morphine, codeine, etc.) and cocaine.

II. Phantastica: Hallucinating substances (we would now say hallucinogens). Here belong a number of vegetable products differing greatly in chemical constitution, which bring on visions, illusions, and hallucinations and which may be accompanied or followed by unconsciousness or other symptoms of altered brain-functioning. Examples are mescal buttons and hemp (hashish, marijuana).

III. Inebriantia: The drugs of drunkenness. "A primary phase of cerebral excitation is followed by a state of de pression which may eventually exten to complete temporary suppression o the functions." (I suppose that Lewin by this last, means passing-out.) Th inebriating drugs include alcoho chloroform, ether, and benzine.

IV. Hypnotica: The sleep-producin agents or sedatives. Lewin lists chlora veronal, and sulphonal. I suppose no we would add some of the barbiturate

V. Excitantia: Mental stimulant now more commonly called analeptic "Substances of vegetable origin whic produce without alteration of con sciousness a generally more or less ap parent excitation of the brain." Her belong the plants containing caffein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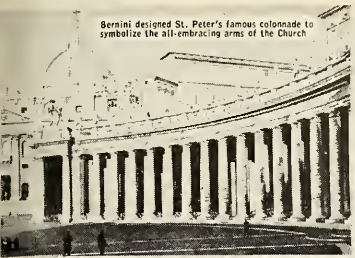
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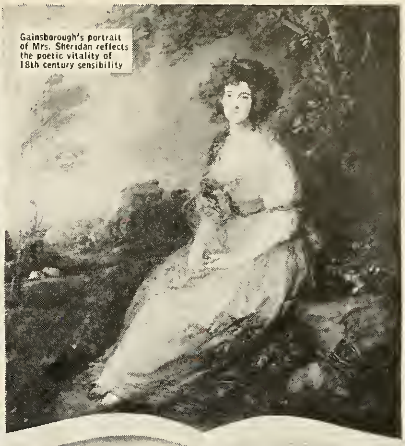
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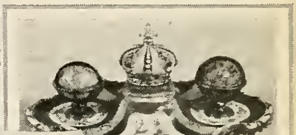
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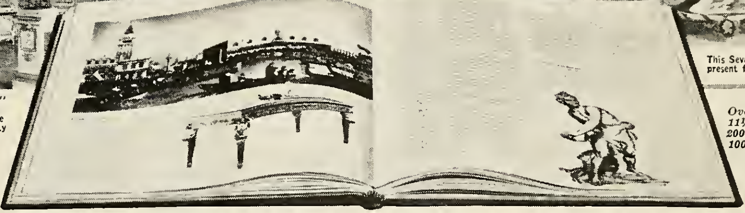
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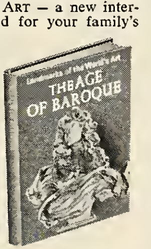

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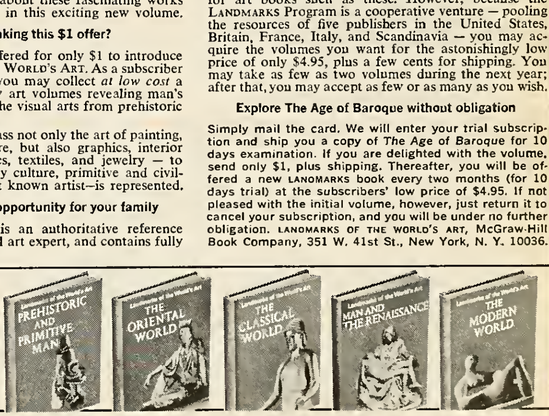

nicotine, and the like—coffee, tea, tobacco, betel.

Today, we would need to add a sixth group, the tranquilizers or, in medical jargon, the ataraxics. The ataraxics are not really new, they are just new to Western science. They stem from the discovery by Westerners in 1947 of sarpaganda, a drug that had been used for many centuries in India by practitioners of a system of medicine known as the Ayur-Veda. Sarpaganda is the powdered root of a small bush, *Rauwolfia serpentina,* and it appears to have been regarded by the Ayur-Vedic physicians as an almost universal panacea for human troubles.

The story of the discovery of *Rauwolfia* by Westerners has been told by the American biochemist Robert S. de Ropp in his book *Drugs and the Mind.* It started with the curiosity of a British biochemist, Sir Robert Robinson, and the enterprise of a Swiss pharmacologist, Dr. Emil Schittler, who persisted for five years in attempts to isolate the sedative substance of crude *Rauwolfia* extracts—a white, crystalline chemical that he named reserpine. Since 1952, when reserpine was announced, a series of other ataraxics has been synthesized by ingenious chemists in various parts of the world and tested on troubled mankind. Spectacular results have been obtained with psychotics and neurotics —and with just ordinary people. Millions of Americans are now tranquilized —with what consequences no one can be sure, because the time has been too short for possible long-term effects to show up. Perhaps we have already reached Huxley's *Brave New World,* where life was made bearable by soma, a drug akin to an Indian beverage.

The ataraxics are, for us at least, the newest of the shortcuts to happiness. The oldest, the most widespread, and still by far the commonest of the chemical shortcuts is alcohol. That early man should have discovered alcohol is not surprising, since sugar-containing fruits ferment easily and quickly enough, especially in the tropics. All one would have to do would be to taste the fermenting fruit and discover the surprising and pleasant effects. The discovery of the fermentation of grain to make beer seems less obvious, as does the cutting of palm flower stalks to get a sweet sap for palm wine—practiced with different palms in widely separated parts of the tropics. Most curious of all is the custom of chewing starchy materials so that they are mixed with saliva and spitting the mixture into a bowl where it rapidly ferments to make an alcoholic beverage. The saliva, of course, converts the starch into sugar. The chewing technique is practiced by such widely different peoples as South American Indians with manihot and Formosan tribes with rice. It is also the method of preparation of the nonalcoholic Pacific kava.

The use of alcoholic beverages is so widespread among living peoples that the exceptions seem curious. The Australian aborigines had no fermented drink, the Indians of North America north of Mexico apparently made little use of alcohol before European contact, and alcoholic drinks were unknown in large areas of the Pacific. The case of the North American Indians is particularly puzzling because they took to alcohol readily enough when they learned about it from Europeans. The Indian tribes of tropical America had a variety of ways of fermenting many different materials, and one would think that the agricultural tribes of the north would have learned about the virtues of fermentation. As for the Pacific, islanders almost everywhere now make toddy from the sap of the cut flower stalks of coconut palms.

Alcohol goes back as far as we have recorded history—and surely much farther. Barley beer is mentioned in the oldest cuneiform writings of Mesopotamia, and some students consider it possible that grains were first cultivated for the purpose of making beer. The Mesopotamians also had wine made from dates and from sesame seeds, and they imported some grape wine from vine-growing regions. Their own vines grew poorly because Dionysus had cursed Mesopotamia. The Egyptians had wine and beer, and drunkenness seems to have been common. The first temperance tracts appear among the papyruses. Wine is also frequently mentioned in the Bible, generally with approval.

The discovery of how to distill strong drink from the weaker wines and beers is relatively modern. Credit for the discovery is generally given to an Arabian alchemist, Jabir ibn Hayyan, known to the West as Geber, who lived about A.D. 800. The possibilities of distilled alcohol, however, were hardly realized until toward the end of the thirteenth century, when Geber's writings reached Arnaldus de Villa Nova, a professor of medicine at the University of Montpellier. Arnaldus, trying the distilling technique, felt he had discovered the philosopher's stone, the key to life everlasting. "Water of life" he called the distillate, and aqua vitae or aquavit it remains to this day for many people. Arnaldus' liquor, of course, was brandy, a distilled wine.

The origin of other distilled liquors is obscure, although it is easy enough to see that once the source of the water of life had been discovered, people would try distilling anything they could ferment. The Dutch discovered gin, flavoring their clear aqua vitae with juniper—the Dutch *junever,* or *jenever,* or the French *genièvre,* under English adaptation became first *geneva,* which was then quickly shortened. Whiskey probably started in Ireland; the word derives from the Irish-Gaelic equivalent of aqua vitae. The ascendancy of Scotland apparently dates from the discovery, in 1860, by an Edinburghian named Andrew Usher that Highland malt whiskey and Lowland grain whiskey made a particularly satisfactory blend. The idea of distilling water of life from fermented molasses seems to have occurred first to the early European settlers in the West Indies, and rum consequently became mixed up with the slave trade and with the early history of the American colonies. Bourbon, a purely American drink distilled from a mash of maize, did not become popular until after 1776.

The human animal, then, has recognized the virtues of alcohol for a long time. He has probably recognized its evils for almost as long, although in most ancient writings the strictures are against drunkenness rather than against drinking itself. The Chinese attitude, as stated in the *Shu Ching* or *Canon of History,* about 650 B.C. sums this up nicely: "Men will not do without beer. To prohibit it and secure total abstinence from it is beyond the power even of sages. Here, therefore we have warnings on the abuse of it."

Total prohibition was, however, tried by Mohammed. He acknowledged tha wine had uses, "but the sin is more heinous than the usefulness." Devou Muslims have in general refrained from alcoholic drink, just as they refrain from eating pork. Yet there has always been a pleasure-loving strain in the Muslim world—witness Omar Khay yam and his jug of wine, his loaf o bread, and thou.

But attempts to control the drinking of alcoholic beverages reached thei greatest extreme in the legislation o English-speaking countries and Scan dinavia. Finland and the United States both tried total legal prohibition, with equally dismal results.

Americans are still suspicious o alcohol, hedging it about with all sort of restrictions, perhaps reasonably so although surely more regulatory consistency among states would do no harm. The other pleasure-giving drug are all either completely prohibited o available only on medical prescription except for Lewin's class of Excitantia tobacco and the pickup drinks like coffee and tea.

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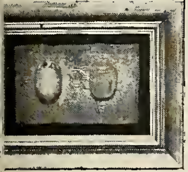
PH-11, height 8⅛″ including black base $20
Plus $2.50 handling and shipping co



SCARAB – SYMBOL OF LIFE ETERNAL
Egypt, 12th-26th Dynasties
(2060-525 B.C.)
Original at
Aladdin House, Ltd., New York

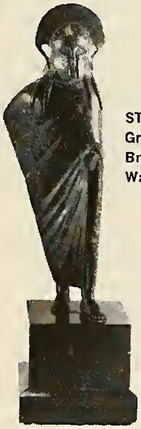
ever popular Scarab, used for centu- to guard against misfortune and sym- ze eternal life, is presented here in a ptured relief plaque handsomely nted on velour in gold antiqued frame. que design shows in exact replica, both of a 2000 year old Egyptian Scarab nst a background of hieroglyphic iptions.

l, 5½″ x 7″ including frame. $12.50
35¢ handling and shipping costs.

MAYAN FIGURINE
Island of Jaina, approx. 6th Century A.D.
Terracotta original at
Aladdin House, Ltd., New York

Dressed in a typical Mayan *ex* or breechclout, and wearing an elaborate headdress complete with ear plugs, this figurine is representative of the noted clay sculptured figurine art of the island of Jaina, off the Campeche Coast of Yucatan. Tastefully mounted on moss green velour in an antiqued gold frame, it is ready to hang and admire.

AT-28, 8″ high including frame $10.50
Plus 75¢ handling and shipping costs.



STATUETTE, DRAPED WARRIOR
Greek, 6th Century B.C.
Bronze original at
Wadsworth Atheneum

Graceful and Symmetrical statuette of a draped Greek warrior. Beautifully rendered in flat, stylized planes, this small figure is considered one of the finest examples of small bronze Archaic Greek Sculpture in America. Several similar figures found in Sparta are presumed to have been votive offerings.

WA-20, height 7½″ including base $18.00
Plus $1.50 handling and shipping costs.

SITTING IBIS
Egypt, about 600 B.
Bronze original at
Oriental Institute of
University of Chicag

This long-legged, golden-bronze wading b was regarded as sacred by the Egyptians.

The ancient Egyptians always placed a gr emphasis on the hereafter. When they look at the gentle Ibis, they saw not a bird, their god Thoth, who was supposed to h on Judgement Day and to have kept reco of both men and the gods. Thoth was of depicted as a man with the head or neck an Ibis, or, as here, entirely as an Ibis.

OR-4, height 4½″ .... $15.
Plus $1.50 handling and shipping costs.

AD OF A MAN, Egyptian
ck Granite, circa 945 B.C.
Walters Art Gallery,
imore, Maryland

culously carved black granite copied from the solemn, pow- figures of the great Middle dom about 2,000 B.C. The rt craftsmanship displayed in recise carving of this very hard must have defied any tools e period. Arrangement of the in cross bands without a cen- part, impossible in real life is a tor's pattern device.

1, height 10¾″ including se $32.00
$4.50 handling and shipping

FACE OF BUDDHA
Siam, 15th - 17th Century A.D.
Bronze original at
Aladdin House Ltd., New York

The serenely contemplative features and quiet repose reflected in the face of this classical Siamese Buddha is characteristic of the bronze sculpture of 15th-17th Century Siam.
The weathered bronze color of the head is magnificently set off by a rich red velour background and antiqued gold wooden frame.

AT-34, 7¾″ high including frame $17.50
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through almost as many changes as have those toward alcohol. There have been sporadic legal prohibitions, and in many places it remains illegal to sell tobacco to minors, although the law is largely a dead letter. It is amusing to see cigarette machines in a college dormitory, where almost everyone is under 21, with a sign saying that no minors are allowed to operate the machine. The Catholic Church at first tried to stop the spread of the tobacco habit, and it wasn't until 1725 that Benedict XIII, who liked to take snuff himself, rescinded the edicts against "dry drunkenness." Louis Lewin cites several countries, including Turkey, Persia, and Russia, in which the death penalty was imposed for smoking. Smoking in the streets or other public places has often been prohibited, and it is still not customary to smoke in places of dignity like churches or law courts. Women who smoked in public in the U.S. before the First World War were not considered respectable.

About the bad effects of smoking there can be no doubt. The link between cigarette smoking and lung cancer seems clearly established, smoking is an important cause of chronic bronchitis, and there is evidence of a relationship between smoking and coronary disease. It is, all in all, a nasty habit and a great nuisance, trying always to keep cigarettes on hand. Yet I haven't been able to break the habit, and the cigarette industry continues to flourish despite all the health warnings. The use of tobacco is classed as "drug habituation" rather than "drug addiction" because there is no demonstrable physical dependence on the drug, with physiological withdrawal symptoms—the symptoms are chiefly a nasty temper and an inability to think about anything except cigarettes. These, however, can be severe enough, as I know.

Tobacco may be chewed, taken as snuff, burned in a pipe, or the dried leaves may be rolled and burned by themselves as in a cigar or with a wrapping of some other substance as in a cigarette. There are endless variations on each of these five basic techniques; particular tribes or regions have often developed their own peculiarities in the use of tobacco. But all five basic methods of use were discovered by the American Indians long before Columbus first dropped anchor off San Salvador and saw the curious habit of "drinking" smoke from burning, rolled leaves. How on earth did the Indians discover all these ways of getting a kick from the dried leaves of the tobacco plant?

But the mystery here is no greater than that surrounding man's discovery of other shortcuts to happiness. Take caffeine, for example. In Asia, Africa, and America early man discovered how to use several different kinds of plants, whose only common link is that they contain this drug. Coffee and kola are African, tea is Asiatic, and maté and guarana are American. Of these, only coffee and tea have conquered the modern Western world (unless Coca-Cola really depends on an extract of the kola nut for its appeal). Why these two have spread, while the others have not, is as mysterious as how they were all discovered in the first place. Maté is a tealike drink commonly used over large parts of Brazil, Argentina, and neighboring countries. It seems to me, at least, as pleasant and refreshing as coffee or tea, but all efforts to develop a wider market have failed, while coffee and tea support great industries and have become the mainstay of the economy of many tropical countries.

Coffee conquered the Near East and then Europe with surprising speed, coming out of the hills of Ethiopia about the year 1000. It has been remarked that if Mohammed had known about coffee, he probably would have prohibited it, but as it is, Muslims, forbidden to drink alcohol, are left with something they can drink to provide a basis for conviviality and stimulation. The coffeehouse takes the place of the saloon. Coffee, to be sure, met some opposition, but nothing comparable to that against alcohol or tobacco.

Other pleasure-giving drugs listed by Lewin among the Excitantia are cocoa, betel, and kava. Cocoa was the drink of the Aztecs and Mayas, but its great popularity in the outside world depends on the European discovery of the combination of cocoa (from Middle America) with sugar (from the sugar cane of India or the Pacific). One could argue whether it should be classed as a drug or as a food, but theobromine is definitely a stimulant, although weaker than caffeine.

The betel nut provides the chief stimulant for millions of people living around the shores of the tropical Pacific and Indian oceans. The preparation of morsels for betel chewing is a somewhat complicated process, involving a piece of areca nut (the fruit of a palm tree, *Areca catechu*), a fresh betel leaf, burnt lime, the leaf of another plant (*Piper betle*), and sometimes other materials. Methods of preparation of the morsel vary from place to place, but once made up it is chewed eagerly until nothing is left. Betel chewing, according to Lewin, arouses a greater craving in the addict than any of the other Excitantia. "The greatest privations and sufferings of human life, insufficient or bad nourishment, hard work, rough weather, and illness lose their disagreeable character before the comforting action of the betel."

One wonders why this soothing morsel has not spread farther afield. Perhaps it is because the betel leaf must be fresh to be effective, or perhaps it is because its various effects are repugnant to European manners. Betel causes copious saliva flow, and we are against spitting (except for those of us who chew tobacco); it results in a bad breath; and it produces a bright-red, bloody-looking mouth, which I find repulsive as well as startling. But for millions in the Pacific tropics, it makes life bearable.

Kava is another Pacific drug, used chiefly by the Melanesians. The drink is based on the fibrous root of a plant, *Piper methyisticum*, which is thoroughly chewed, usually by the young men and boys with strong teeth; the masticated product is spat into a bowl and diluted with water for drinking. There is no fermentation, so the process is quite different from that of chewing starchy roots to make alcohol. Here the active principle is a resinous substance that Lewin named *yangonin*. This drug produces a euphoric state, "refreshes the fatigued body and brightens and sharpens the intellectual faculties," to quote Lewin. "Kava has a soothing effect. Those who drink it are never choleric, angry, aggressive and noisy, as in the case of alcohol."

It sounds like a pleasant and innocuous shortcut to happiness, but it was bitterly denounced by the missionaries, who succeeded in abolishing the use of kava on many of the islands. It seems to have been largely a social and ceremonial drink used when entertaining guests, discussing public affairs, negotiating with other tribes, or celebrating some event like the planting of trees or the building of houses. Europeans have tried to prepare it by substituting grinding and mashing for the chewing process, but the end product in this case is said to be inferior to the more traditional preparation.

Here I have already written extensively on drugs and hardly mentioned the products of hemp, of poppy, or of the coca tree, nor any of the odd products that various peoples have used to find illusion, heightened perception, or peace of mind. There remains always the puzzling problem of how our ancestors discovered these pleasure-giving drugs. And the problem, still with us, of whether they are good or bad: whether they should be prohibited by society, controlled, or freely indulged in. It is clear that we cannot look at these drugs without prejudice, and that our attitudes are as much a consequence of our culture as they are a consequence of the properties of the drugs themselves.

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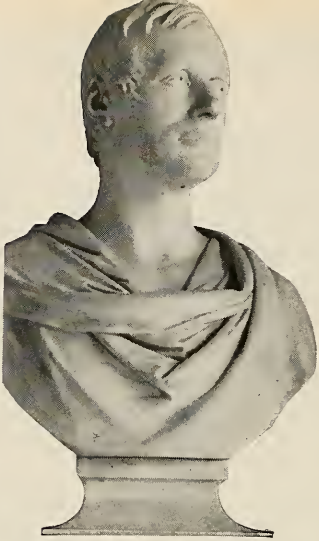

The Rise and Fall of Sir Stamford Raffles: Colonialist, Naturalist

by Robert Silverberg

In 1818, an expedition searching for natural wonders made its way through the uncharted hill country of Sumatra. Its leader was 37-year-old Sir Thomas Stamford Raffles, one of the many British colonialists whose assignment to a remote land led to an appreciation of natural history. He was the lieutenant-governor of the outpost of Sumatra and was accompanied on this arduous trip by his wife, and by Dr. Joseph Arnold, a botanist; Edward Presgrave, a local official of the British East India Company; six native officers; and fifty coolies.

On the second day the expedition came upon the extraordinary plant whose discovery won Raffles a place in the annals of botany. It bore a vast, red flower, more than a yard across from petal tip to petal tip, that seemingly sprouted without a stem from a host plant. Of its blooming pattern he wrote: "It appears at first in the form of a small round knob, which gradually increases in size. The flower-bud is invested by numerous membranaceous sheaths, which surround it in successive layers, and expand as the bud enlarges, until at length they form a cup round its base. . . . The inside of the cup is of an intense purple, and more or less densely yellow, with soft flexible spines of the same colour; towards the mouth it is marked with numerous depressed spots of the purest white. . . . The petals are brick-red with numerous pustular spots of a lighter colour. The whole substance of the flower is not less than half an inch thick, and of a firm fleshy consistence."

This enormous, parasitic plant, adorned with the world's largest flower, now bears the name of *Rafflesia arnoldii* in honor of its two discoverers. Raffles' later studies showed that its seeds, generally carried by elephants' feet, lodge in surface-lying roots of the shrub *Cissus angustifolia*, penetrate the bark, and germinate, forming a ring of tissue. In time, buds sprout from the bark and grow as big as cabbages, unfolding into spectacular, foul-smelling blooms. The flower weighs some fifteen pounds, and its central cup can hold six quarts of water.

Raffles represented a type of naturalist now virtually extinct. He was a gentleman amateur who mastered the disciplines of science and made contributions of enduring value to botany. By profession he was an empire-builder, responsible for much of the vast extension of British power in Southeast Asia.

Born on shipboard in the West Indies in 1781, Thomas Stamford Raffles was the son of Benjamin Raffles, a captain in the English West Indies trade. He was an intelligent child, but because of family poverty had to abandon his formal education at the age of fourteen to take a clerkship in the London office of the East India Company. He scribbled away from ten in the morning until eleven at night, handling documents concerned with remote, romantic places, such as Calcutta, Malacca, Penang, and Bombay. After office hours he mastered French and studied natural science. His earnestness, diligence, and probably also his shrewd cultivation of influential superiors won him preferment over the years, and in 1805 he was sent out to the Malayan colony of Penang to be assistant secretary to the new governor. He was twenty-four years old and had just married a widow ten years his senior.

In the month before his departure Raffles began his studies of the Malay language. His ability to act as an interpreter aided him in Penang, and his clear-minded approach to administrative problems enabled him to undertake an increasing amount of responsibility. The Dutch were then the leading colonial figures in Southeast Asia, and Raffles saw himself as the architect of countervailing British power there. He became secretary to the governor at Penang in 1807, but because of ill health was ordered to Malacca, which was being dismantled as a post for the East India Company. There he urged the retention of the post, explaining its great importance in a long report to the governor-general, Lord Minto. The report did its work, and the company decided to reverse its plans.

He moved from post to post with increasing authority—from Malacca to Calcutta and from Calcutta back to Malacca. There, often failing to move his superiors to action, Raffles consoled himself with the study of natural history. Abdullah, a Malayan interpreter, later wrote that he kept four persons on wages, "one to go to the forests in search of various kinds of leaves, flowers, fungi, pulp, and such like products. Another he sent to collect all kinds of flies, grasshoppers, bees in all their varieties, as well as scorpions, centipedes, and such like, giving him needles as well as pins with a box to stick the creatures therein. Another he sent with a basket to seek for coral, shells, oysters, mussels, cockles, and such like; also fishes of various species; and another to collect animals, such as birds, jungle fowl, deer, stags, mouse-deers and so forth. Then he had a large book with thick paper, whose use was for the keeping of the leaves and flowers. . . . He kept a barrel full of arrack, or brandy, and when he had got snakes, scorpions, centipedes, or such like, he would put them into it till they were dead, before putting them in bottles."

The amused people of Malacca brought Raffles specimens of everything that flew, swam, or crawled. Local potentates sent tigers, orangutans gibbons, and other handsome gifts Raffles' diplomatic assignment at Malacca was to wean these sultans away from the Dutch and get them to support British colonial ambitions, and his tact and understanding earned him their warm co-operation in his studies

When Napoleon annexed Holland a gradual process that culminated in 1810, the Dutch overseas possessions came into the hands of the French—England's adversary. Raffles suggested to Lord Minto that the British seize the rich island of Java, occupied by a thin garrison of French troops, and hold it "in safekeeping" against the day the Dutch might regain their independence. This was done, and Minto appointed Raffles lieutenant-governor of the island. From 1811 to 1816 he was absolute ruler there, taking bold, imag

African Panoranimal.

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inative steps to increase the island's revenues and streamline its administration. His sweeping moves—perhaps for their dash alone—earned him the enmity of more conservative officials, however, who denounced him to the home office. He was constantly compelled to defend his actions to the far-off, not always sympathetic directors of the East India Company in London.

The death of his wife Olivia in 1814 plunged Raffles into a gloom that he alleviated only through study. Despite the trying climate, which had greatly impaired his strength, he explored Java endlessly: observing a volcanic eruption at close range, examining the ruined monuments of jungle-swallowed dynasties, and collecting strange animals and plants. He undertook various excursions inland from the coast and eventually crossed the island from one sea to the other. On one of these journeys he discovered *Rafflesia arnoldii.*

With the downfall of Napoleon, Java reverted to Dutch control, and Raffles was ordered back to London in 1816 to account for certain details of his administration. He acquitted himself well enough to become governor of Benkulen, Sumatra, but the settlement was small, and he knew that, in actuality, he had been sent into political exile. Fortunately, Sumatra held attractions for him as a scientist—with its rain-soaked forests, volcanic peaks, and wealth of living ceatures.

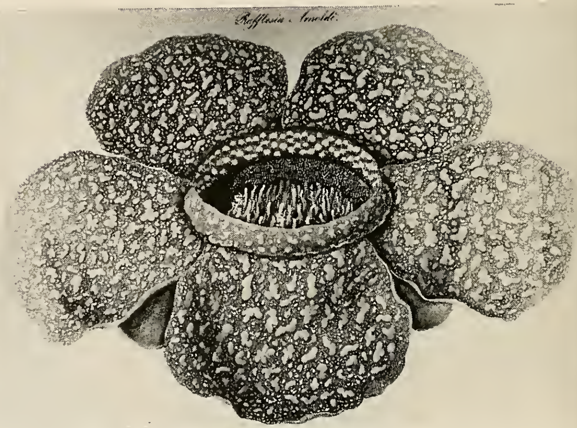
At thirty-nine, although harried by tropical fevers and withered and yellowed like a man twice his age, Raffles continued to explore tirelessly, usually accompanied by his second wife, Sophia. *Rafflesia* was the most remarkable of his finds, but there were many others, including the plant *Nepenthes rafflesiana.* Once he visited a cannibal tribe, the Bataks (or Battas), reporting that they ate human flesh "raw or grilled, and generally dipped in Sambul [a preparation of chili pepper and salt], which is always in readiness." He wrote a friend that he was forming a collection of skulls—"some from Battas that have been eaten."

His house, he wrote, was "on one side a perfect menagerie, on another a perfect flora; here a pile of stones, there a collection of seaweeds, shells, etc." By 1820 there were three Raffles children, and Lady Raffles, in her *Memoir of Sir Thomas Stamford Raffles,* told of how the doting father gave them two tiger cubs and a bear for pets. "It was rather a curious scene to see the children, the bear, the tigers, a blue mountain bird and a favourite cat all playing together, the parrot's beak being the only object of awe to all the party."

Raffles busied himself assembling mammals to ship to London. His botanical and anthropological collections also grew steadily. "I have thrown politics far away," he declared, "and since I must have nothing more to do with men have taken to the wilder but less sophisticated animals of the woods." One of his triumphs was the discovery, in 1818, of the hitherto unknown Asiatic tapir, *Tapirus indicus,* although the famous French zoologist Georges Cuvier had declared in 1812 that "there is little hope that we shall discover further new species of large mammals in the future." Convinced that there was such a tapir after coming upon the skin of a specimen shot by his predecessor, Raffles confounded Cuvier by tracking down a live one. "It is the most docile animal I ever met with," he observed, "and is more like the hog than any other animal. . . ."

About 1818, Raffles was visited by two itinerant Frenchmen on a collecting expedition. One, Alfred Duvaucel, was the stepson of Cuvier. Duvaucel sent back to Paris the news of the tapir's existence and wrote detailed descriptions of the other creatures in Raffles' private zoo, including two handsome clouded leopards (*Neofelis nebulosa*) "which allow themselves to be stroked and petted and have a continual desire to play, like domestic cats." Raffles was pleased to display his treasures, his gibbons and siamangs, his champagne-drinking Malayan sun bear, and his colorful Sumatran birds. But his pleasure vanished when he found that Cuvier, using Duvaucel's report, had published a scientific account of the tapir, robbing him of priority.

Greater misfortunes were ahead. His eldest son died of dysentery in July, 1821. Another child died on January 3, 1822, and a third twelve days later. Raffles placed a surviving child, an infant, on a ship bound for England and made plans to leave the tropics himself. Before he left, however, he was ordered to set up a system of government in Singapore, which he had founded for trade purposes in 1819, and which, in a few years, had become the most important commercial center between Calcutta and Hong Kong. In 1822 he found the island flourishing, and among his many other activities he found time to establish a botanical garden there. Meanwhile, he engaged Abdullah to assemble a collection of Malay books and manuscripts, musical


Rafflesia Arnoldi.

Dr. Arnold, who accompanied Sir Stamford Raffles on a tour in the island of Sumatra in the year 1818 . . . called "[the plant] the greatest prodigy of the vegetable world. . . . I had ventured," he continues, "some way from the party, when one of the Malay servants came running to me with wonder in his eyes, and said, 'Come with me, sir, come! A flower, very large, beautiful, wonderful!' I immediately went with the man about a hundred yards in the jungle, and he pointed to a flower growing close to the ground, under the bushes, which was truly astonishing. My first impulse was to cut it up, and carry it to the hut. I therefore seized the Malay's parang, a sort of instrument like a woodman's chopping-hook, and finding that it sprang from a small root which ran horizontally (about as large as two fingers, or a little more), I soon detached it, and removed it to our hut. To tell you the truth, had I been alone, and had there been no witnesses, I think I should have been fearful of mentioning the dimensions of this flower, so much does it exceed every flower I have ever seen or heard of."

The Gardener's Chronicle
January 17, 1874

nstruments, paintings, and sacred images to take back to England.

He then returned to Benkulen for a ear and early in 1824 supervised the oading of his collections on board the ngland-bound *Fame*. The tame tapir vent aboard, and the clouded leopards, he birds and the stuffed animals, the Malay books and manuscripts, thouands of drawings, notes for a history f Sumatra and Borneo he hoped to vrite, a map of the island that had aken six months to prepare, and the kulls of former cannibals. The *Fame* ailed at daybreak on February 2. That vening, fifty miles out at sea, a steward carrying a torch went to draw randy from a cask. A spark flashed, nd in ten minutes the ship was in lames. The passengers escaped in oats, leaving all their belongings beind, and by the light of the conflagraion Raffles watched his animals and ossessions destroyed. The ship, which e had called "a perfect Noah's ark," vent down and nothing was salvaged.

Back on Sumatra the following morning Raffles set to work collecting more nimals. But the old vigor was gone. Ie engaged another ship to return to ngland and landed at Plymouth in ugust, 1824. In London he busied imself with his last great work, the ounding of the Zoological Society of ondon, of which he was the first president. The British East India Company velcomed him in chilly fashion, comnending him austerely for his years of ervice and for his Singapore enterrise, but presenting a numbing bill for 22,000 supposedly drawn without auorization from company coffers durng his career. He drew up a statement f his administration during the preious twelve years—principally from emory—but even this did not justify im in the eyes of the directors.

The failure of Raffles' Malayan bankrs wiped out the remainder of Raffles' apital, and although he was only in is early forties, his strength gradually bbed. On the morning of his fortyfth birthday, July 5, 1826, he was und dead of a stroke at the foot of a aircase in his home.

To political historians, Raffles' enuring monument is the thriving city f Singapore, which he so shrewdly nd foresightedly created on his own itiative. To natural historians, however, he is remembered by two less ajestic tributes: his name attached a certain malodorous and gigantic umatran flower, and his bust serenely rveying the Lion House in the Lonon Zoo he helped found.

obert Silverberg is a versatile writer hose subjects range from archeology science fiction. His biography of homas Edison will be published by an Nostrand sometime this year.

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Joel Adler, 2635 Haring Street, Brooklyn, New York
Shaving with the ACCUMEN is a pleasurable experience. I now realize that a close, non-irritating shave is possible with an electric. The formidable powerplant, if charged overnight, lasts for two weeks of shaves.

Roger P. Siegel, 2036 E. 22nd Street, Cleveland, Ohio
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Please send me another ACCUMEN Shaver. This is the third one I have ordered—my friends seem to like them too much. If this keeps up I might become your East Coast representative.

Robert Buckner, 818 N. Doheny Drive, Los Angeles 69, California
There is only one word for the ACCUMEN—"superb". Please send me another one. I want it for my son's birthday.

L. D. Myrah, Williamson Bldg., Cleveland, Ohio
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Yanomamö—The Fierce People

Bizarre duels and treacherous internecine warfare are chronic in tribe of South American Indians who take pride in violence and in the idea that they were the first people created, and the finest

by *Napoleon A. Chagnon*

The Yanomamö Indians are a tribe in Venezuela and Brazil who practice a slash-and-burn way of horticultural life. Traditionally, they have been an inland "foot" tribe, avoiding larger rivers and settling deep in the tropical jungle. Until about 1950 they had no sustained contact with other peoples except, to a minor extent, with another tribe, the Carib-speaking Makiritaris to the northeast.

I recently lived with the Yanomamö for more than a year, doing research sponsored by the U.S. Public Health Service, with the co-operation of the Venezuela Institute for Scientific Research. My purpose was to study Yanomamö social organization, language, sex practices, and forms of violence, ranging from treacherous raids to chest-pounding duels (*as shown above*).

Those Yanomamö who have been encouraged to live on the larger rivers (Orinoco, Mavaca, Ocamo, and Padamo) are slowly beginning to realize that they are not the only people in the world; there is also a place called Caraca-tedi (Caracas), from whence come foreigners of an entirely new order. These foreigners speak an incomprehensible language, probably a degenerate form of Yanomamö. They bring malaria pills, machetes, axes, cooking pots, and *copetas* ("guns"), have curious ideas about indecency, and speak of a new "spirit."

However, the Yanomamö remain a people relatively unadulterated by outside contacts. They are also fairly numerous. Their population is roughly 10,000, the larger portion o them distributed throughout southern Venezuela. Here, in basins of the upper Orinoco and all its tributaries they dwell in some 75 scattered villages, each of which contains from 40 to 300 individuals.

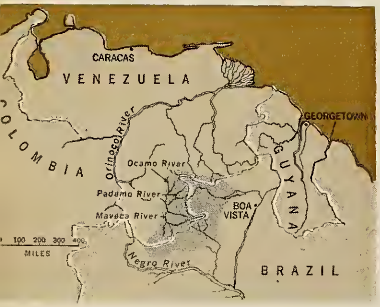
The largest, most all-embracing human reality to these people is humanity itself; Yanomamö means true human beings. Their conception of themselves as the only true "do

estic" beings (those that dwell in ouses) is demonstrated by the con- empt with which they treat non- anomamö, who, in their language, re "wild." For instance, when re- erring to themselves, they use an onorific pronoun otherwise reserved r important spirits and headmen; hen discussing *nabäs* ("non-Yano- amö"), an ordinary pronoun is nough. Again, in one of the myths bout their origin, the first people to e created were the Yanomamö. All hers developed by a process of de- eneration and are, therefore, not ite on a par with the Yanomamö.

In addition to meaning "people," anomamö also refers to the language. Their tribal name does not designate a politically organized entity but is more or less equivalent to our concept of humanity. (This, of course, makes their most outstanding characteristic—chronic warfare, of which I shall speak in detail—seem rather an anomaly.) Sub-Yanomamö groupings are based on language differences, historical separation, and geographical location.

For instance, two distinguishable groups, Waika (from *waikaö*—"to kill off") and Shamatari, speak nearly identical dialects; they are differentiated mostly on the basis of a specific event that led to their separation. The Shamatari, the group I know best, occupy the area south of the Orinoco to, and including portions of, northern Brazil. Their differentiation from the Waika probably occurred in the past 75 years.

According to the Indians, there was a large village on a northern tributary of the upper Orinoco River, close to its headwaters. The village had several factions, one of which was led by a man called Kayabawä (big tree). A notably corpulent man, he also had the name Shamatari, derived from *shama*, the "tapir," a robust ungulate found throughout tropical South America. As the story goes, Shamatari's faction got into a fight with the rest of the village over



Shaded area is jungle region of Brazil and Venezuela where Yanomamö dwell —a terrain penetrated by several rivers.

Young Yanomamö climb and romp like other children. When grown up, they cut clubs and spears from such trees.

Monkey meat, smoked and dried, serves as a feast delicacy after being boiled in hot water to soften it for the guests.

the possession of a woman, and the community split into two warring halves. Gradually the fighting involved more villages, and Shamatari led his faction south, crossed the Orinoco, and settled there. He was followed by members of other villages that had taken his part in the fight.

Those who moved to the south side of the Orinoco came to be called Shamataris by those living on the north side, and the term is now applied to any village in this area, whether or not it can trace its origin to the first supporters of Shamatari.

For the Yanomamö, the village is the maximum political unit and the maximum sovereign body, and it is linked to other villages by ephemeral alliances, visiting and trade relationships, and intermarriages. In essence, the village is a building—a continuous, open-roofed lean-to built on a circular plan and surrounded by a protective palisade of split palm logs. The roof starts at or near ground level, ascends at an angle of about 45 degrees, and reaches a height of some 20 to 25 feet. Individual segments under the continuous roof are not partitioned; from a hammock hung anywhere beneath it one can see (and hear, thanks to the band shell nature of the structure) all that goes on within the village.

The palisade, about three to six feet behind the base of the roof, is some ten feet high and is usually in various stages of disrepair, depending on the current warfare situation. The limited number of entrances are covered with dry palm leaves in the evening; if these are moved even slightly, the sound precipitates the barking of a horde of ill-tempered, underfed dogs, whose bad manners preadapt the stranger to what lies beyond the entrance.

A typical "house" (a segment under the continuous roof) shelters a man, his wife or wives, their children, perhaps one or both of the man's parents, and, farther down, the man's brothers and their families. The roof is alive with cockroaches, scorpions, and spiders, and the ground is littered with the debris of numerous repasts—bird, fish, and animal bones; bits of fur; skulls of monkeys and other animals; banana and plantain peelings; feathers; a the seeds of palm fruits. Bows a arrows stand against housepoles over the village, baskets hang fro roof rafters, and firewood is stack under the lower part of the ro where it slopes to the ground. So men will be whittling arrow poi with agouti-tooth knives or tyi feathers to arrow shafts. So women will be spinning cotton, wea ing baskets, or making hammoc or cotton waistbands. The childre gathered in the center of the villa clearing, frequently tie a string to lizard and entertain themselves shooting the animal full of tiny a rows. And, of course, many peop will be outside the compound, wo ing in their gardens, fishing, or c lecting palm fruits in the jungle.

If it is a typical late afternoo most of the older men are gathered one part of the village, blowing o of their hallucinatory drugs (*eben* up each other's nostrils by means a hollow tube and chanting to t forest demons (*hekuras*) as the dr takes effect. Other men may be cu ing a sick person by sucking, m saging, and exhorting the evil spi from him. Everybody in the village swatting vigorously at the voracio biting gnats, and here and the groups of people delouse each ot er's heads and eat the vermin.

In composition, the village co sists of one or more groups of p rilineally related kinsmen (*mashis* but it also contains other categori including people who have co from other villages seeking spous All villages try to increase their si and consider it desirable for both t young men and young women to r main at home after marriage. Sin one must marry out of his *mash* villages with only one patrilinea frequently lose their young men other villages; they must go to a other village to *siohamou* (to "so in-law") if they want wives. The pa ents of the bride-to-be, of cours want the young man to remain their village to help support them their old age, particularly if th have few or no sons. They will fr quently promise a young man one more of the sisters of his wife in o der to make his stay more attractiv

He, on the other hand, wou rather return to his home village to l vith his own kinsmen, and the tendncy is for postmarital residence to e patrilocal (with the father of the room). If a village is rich in axes nd machetes, it can and does coerce ts poorer trading partners into pernitting their young women to live ermanently with the richer village. he latter thus obtains more women, vhile the poorer village gains some ecurity in the trading network. The oor village then coerces other vilages even poorer, or they raid them nd steal their women.

The patrilineages that maintain he composition of the villages, rich r poor, include a man and his brothrs and sisters, his children and his rothers' children, and the children f his sons and brothers' sons. The deal marriage pattern is for a group f brothers to exchange sisters with nother group of brothers. Furtherore, it is both permissible and esirable for a man to marry his other's brother's daughter (his atrilateral cross-cousin) and/or his ather's sister's daughter (his patriteral cross-cousin) and, as we have een earlier, to remain in his parents' illage. Hence, the "ideal" village ould have at least two patrilineages at exchanged marriageable people.

There is a considerable amount of dherence to these rules, and both rother-sister exchange and cross-ousin marriage are common. Howver, there are also a substantial umber of people in each village who re not related in these ways. For the ost part they are women and their hildren who have been stolen from ther villages, segments of lineages hat have fled from their own village ecause of fights, and individuals—nostly young men—who have moved n and attached themselves to the ousehold of one of the lineage *mashi*) leaders.

Even if the sex ratio is balanced, here is a chronic shortage of women. A pregnant woman or one who is still ursing her children must not have exual relationships. This means that or as many as three years, even alowing for violations of the taboos, woman is asexual as far as the men re concerned. Hence, men with regnant wives, and bachelors too, re potentially disruptive in every

Although violent, Yanomamö have close, often warm, ties with kinfolk. This man plays with his sister's son.

Below, village women go fishing in a dammed creek. After mild poison stuns the fish, they are captured in baskets.

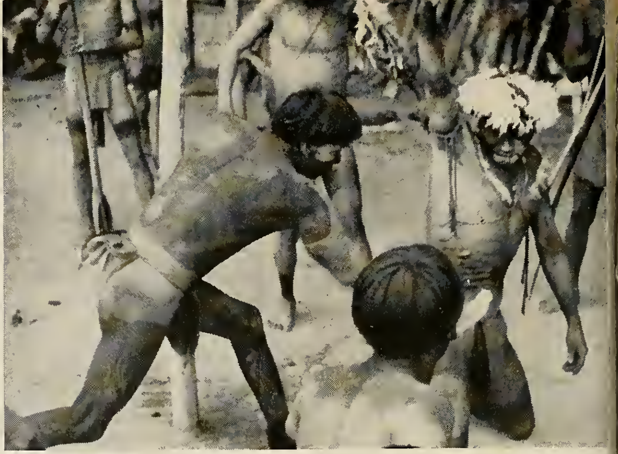
village because they constantly seek liaisons with the wives of other men. Eventually such relationships are discovered and violence ensues.

The woman, even if merely suspected of having affairs with other men, is beaten with a club; burned with a glowing brand; shot with a barbed arrow in a non-vital area, such as the buttocks, so that removal of the barb is both difficult and painful; or chopped on the arms or legs with a machete or ax. Most women over thirty carry numerous scars inflicted on them by their enraged husbands. My study of genealogies also indicates that not a few women have been killed outright by their husbands. The woman's punishment for infidelity depends on the number of brothers she has in the village, for if her husband is too brutal, her brothers may club him or take her away and give her to someone else.

The guilty man, on the other hand, is challenged to a fight with clubs. This duel is rarely confined to the two parties involved, for their brothers and supporters join the battle. If nobody is seriously injured, the matter may be forgotten. But if the incidents are frequent, the two patrilineages may decide to split while they are still on relatively "peaceable" terms with each other and form two independent villages. They will still be able to reunite when threatened by raid from a larger village.

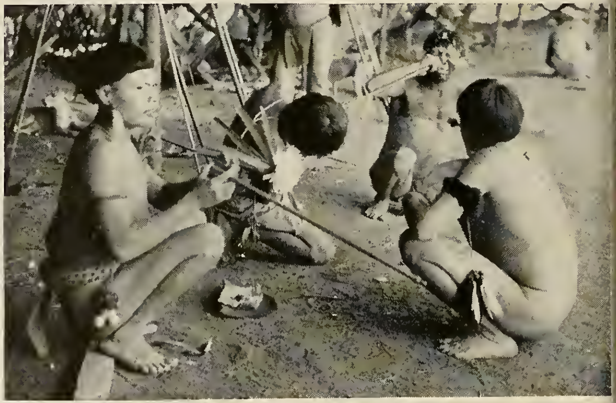
This is only one aspect of the chronic warfare of the Yanomamö—warfare that has a basic effect on settlement pattern and demography, intervillage political relationships, leadership, and social organization. The collective aggressive behavior is caused by the desire to accent "sovereignty"—the capacity to initiate fighting and to demonstrate this capacity to others.

Although the Yanomamö are habitually armed with lethal bows and arrows, they have a graded system of violence within which they can express their *waiteri*, or "fierceness." The form of violence is determined by the nature of the affront or wrong to be challenged. The most benign form is a duel between two groups, in which an individual from each group stands (or kneels) with his



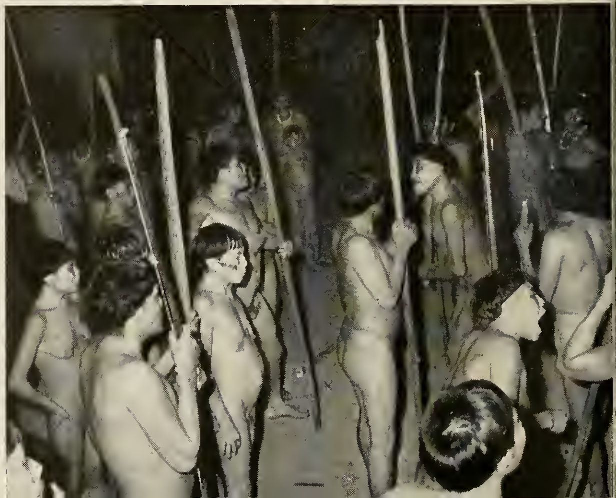
Chest-pounding duel is gentlest form of violence—a formalized fist fight.

Opponents take turns. Here, kneeli Indian is accepting a powerful blo



In preparation for duels, the Indians take their hallucinatory drug, ebene. *Above, one blows* ebene *up the other's nostrils through a long hollow tube.*

Club fighting is a bloodier duel th chest pounding, and it often becom a free-for-all. Yanomamö grip clu below, as their tempers grow h



chest stuck out, head up in the air, and arms held back and receives a hard blow to the chest. His opponent literally winds up and delivers a closed-fist blow from the ground, striking the man on the left pectoral muscle just above the heart. The impact frequently drops the man to his knees, and participants may cough up blood for several days after such a contest. After receiving several such blows, the man then has his turn to strike his opponent, while the respecive supporters of each antagonist gather around and frenziedly urge heir champion on.

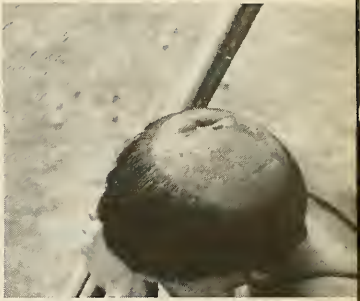
All men in the two villages are obliged to participate as village epresentatives, and on one occasion saw some individuals take as many as three or four turns of four blows ach. Duels of this type usually reult from minor wrongs, such as a illage being guilty of spreading bad umors about another village, quesioning its generosity or fierceness, or ccusing it of gluttony at a feast. A ariant of this form of duel is side lapping, in which an open-handed low is delivered across the flank just bove the pelvis.

More serious are the club fights. lthough these almost invariably reult from cases in which a wife has een caught in an affair with another man, some fights follow the theft of ood within the village. The usual rocedure calls for a representative rom each belligerent group. One man holds a ten-foot club upright, races himself by leaning on the club nd spreading his feet, then holds his ead out for his opponent to strike. ollowing this comes his turn to do kewise to his adversary. These uels, more often than not, end in a ee-for-all in which everybody clubs verybody else on whatever spot he an hit. Such brawls occasionally reult in fatalities. However, since eadmen of the respective groups and by with bows drawn. no one ares deliver an intentionally killing low, for if he does, he will be shot. he scalps of the older men are almost incredible to behold, covered as hey are by as many as a dozen ugly elts. Yet, most of them proudly have the top of their heads to disay their scars.

Also precipitated by feuds over omen are spear fights, which are even more serious than club fights. Members of a village will warn those of the offending village that they are coming to fight with spears. They specify that they are not planning to shoot arrows unless the others shoot first. On the day of the fight, the attackers enter the other village, armed with five or six sharpened clubs or slender shafts some eight feet long and attempt to drive the defenders out. If successful, the invaders steal all the valuable possessions—hammocks, cooking pots, and machetes—and retreat. In the spear fight that occurred while I was studying the tribe, the attackers were successful, but they wounded several individuals so badly that one of them died. The fighting then escalated to a raid, the penultimate form of violence.

Such raids may be precipitated by woman stealing or the killing of a visitor (visitors are sometimes slain because they are suspected of having practiced harmful magic that has led to a death in the host's village). Raids also occur if a man kills his wife in a fit of anger; her natal village is then obliged to avenge the death. Most raids, however, are in revenge for deaths that occurred in previous raids, and once the vendetta gets started, it is not likely to end for a long time. Something else may trigger a raid. Occasionally an ambitious headman wearies of peaceful times—a rarity, certainly—and deliberately creates a situation that will demonstrate his leadership.

A revenge raid is preceded by a feast in which the ground bones of the person to be avenged are mixed in a soup of boiled, ripe plantains (the mainstay of Yanomamö diet) and swallowed. Yanomamö are endocannibals, which means they consume the remains of members of their own group. This ceremony puts the raiders in the appropriate state of frenzy for the business of warfare. A mock raid—rather like a dress rehearsal—is conducted in their own village on the afternoon before the day of the raid, and a life-size effigy of an enemy, constructed of leaves or a log, is slain. That evening all the participants march, one at a time, to the center of the village clearing, while clacking their bows and arrows



Proud of their courage, most of the Indians shave the top of the head to display scars and welts that resulted from blows accepted in a formal club duel.

and screaming their versions of the calls of carnivorous birds, mammals, and even insects.

When all have lined up facing the direction of the enemy village, they sing their war song, "I am a meat-hungry buzzard," and shout several times in unison until they hear the echo return from the jungle. They then disperse to their individual sections of the village to vomit the symbolic rotten flesh of the enemy that they, as symbolic carnivorous vultures and wasps, partook of in the lineup. The same thing, with the exception of the song, is repeated at dawn the following morning. Then the raiders, covered with black paint made of chewed charcoal, march out of the village in single file and collect the hammocks and plantains that their women have previously set outside the village for them. On each night they spend en route to the enemy they fire arrows at a dummy in a mock raid. They approach the enemy village itself under cover of darkness, ambush the first person they catch. and retreat as rapidly as possible. If they catch a man and his family. they will shoot the man and steal the woman and her children. At a safe distance from her village. each of the raiders rapes the woman, and when they reach their own village, every man in the village may, if he wishes, do likewise before she is given to one of the men as a wife. Ordinarily she attempts to escape, but if caught, she may be killed. So constant is the threat of raids that every woman leaves her village in the knowledge that she may be stolen.

More savage than club fighting is the revenge raid, preceded by feasting, above. Raiders here take turns with a soup containing ground human bones.

Preparing for a raid, the Yanomamö dance in the village compound while frenziedly waving their bows and busily clacking their arrows.

As a result, she always takes he smaller children with her, preferrin that they be abducted, too, rathe than remain to die from starvation

The supreme form of violence is th *nomohoni*—the "trick." During th dry season, the Yanomamö do a grea deal of visiting. An entire village wi go to another village for a ceremon that involves feasting, dancing chanting, curing, trading, and jus plain gossiping. Shortly after arriva the visitors are invited to recline i the hammocks of the hosts. By custo they lie motionless to display thei fine decorations while the hosts prepare food for them. But now suppos that a village has a grudge to settl with another, such as deaths t avenge. It enlists the support of third village to act as accomplice This third village, which must be o friendly terms with the intended victims, will invite them to a feast. Whil the guests recline defenseless in th hammocks, the hosts descend on the with axes and sharpened poles treacherously killing as many as the can. Those that manage to escape th slaughter inside the village are sho outside the palisade by the villag that instigated the *nomohoni*. Th women and children will be share between the two accomplices.

Throughout all this ferocity ther are two organizational aspects of violence. One concerns leadership: man must be able to demonstrate hi fierceness if he is to be a true leade It is equally important, however, tha he have a large natural following- that is, he must have many male kin men to support his position and quantity of daughters and sisters t distribute to other men. Lineag leaders cannot accurately be described as unilateral initiators of activities; rather, they are the vehicle through which the group's will is expressed. For example, when a certai palm fruit is ripe and is particularl abundant in an area some distanc from the village, everybody know that the whole village will pack it belongings and erect a temporar

Treachery is a highly rated for violence. These dancers are vis who have come for a feast that develop into a planned massacre.

Usual time for a massacre to begin is when guests, awaiting the promised feast, recline in hammocks of their hosts and display their decorations.

One wrong breeds another among the chronically violent Yanomamö. A band of revenge raiders is shown, below, as it starts out at dawn.

camp at that spot to collect the fruit. The headman does little more than set the date. When his kinsmen see him packing, they know that the time has come to leave for the collecting trip. True, the headman does have some initiative in raiding, but not even this is completely independent of the attitudes of his followers, which dictate that a death must be avenged. However, when the purpose of a raid is to steal women, the headman does have some freedom to act on his own initiative.

As a general rule, the smaller his natural following, the more he is obliged to demonstrate his personal qualities of fierceness and leadership.

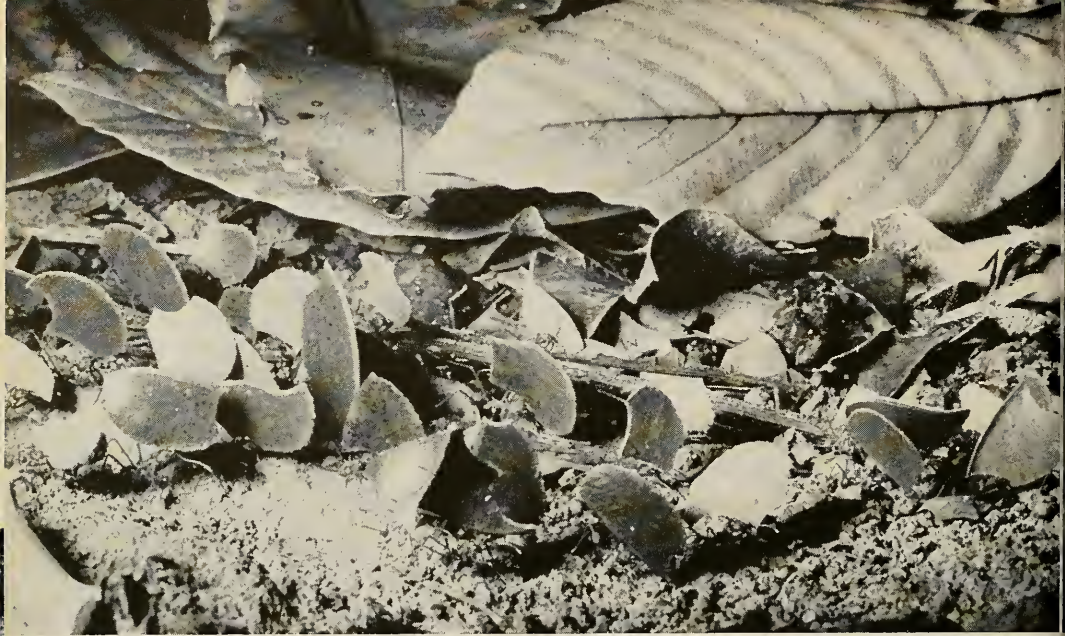
Padudiwä, the headman of one of the lineages in Bisaasi-tedi, took pains to demonstrate his personal qualities whenever he could; he had only two living brothers and four living sisters in his group. Most of his demonstrations of ferocity were the cruel beatings he administered to his four wives, none of whom had brothers in the village to take their part. Several young men who attached themselves to his household admired him for this.

Padudiwä was also responsible for organizing several raids while I lived with the villagers of Bisaasi-tedi. Every one of them was against Patanowä-tedi, a village that was being raided regularly by some seven or eight other villages, so that the danger of being raided in return was correspondingly reduced. On one occasion, when three young men from Patanowä-tedi arrived as emissaries of peace, Padudiwä wanted to kill them, although he had lived with them at one time and they were fairly close relatives. The murder was prevented by the headman of the other—and larger—lineage in the village, who warned that if an attempt were made on the lives of the visitors he himself would kill Padudiwä.

Obviously then, Padudiwä's reputation was built largely on calculated acts of fierceness, which carefully reduced the possibility of personal danger to himself and his followers, and on cunning and cruelty. To some extent he was obliged by the smallness of his gathering to behave in such a way, but he was certainly a man to treat with caution.

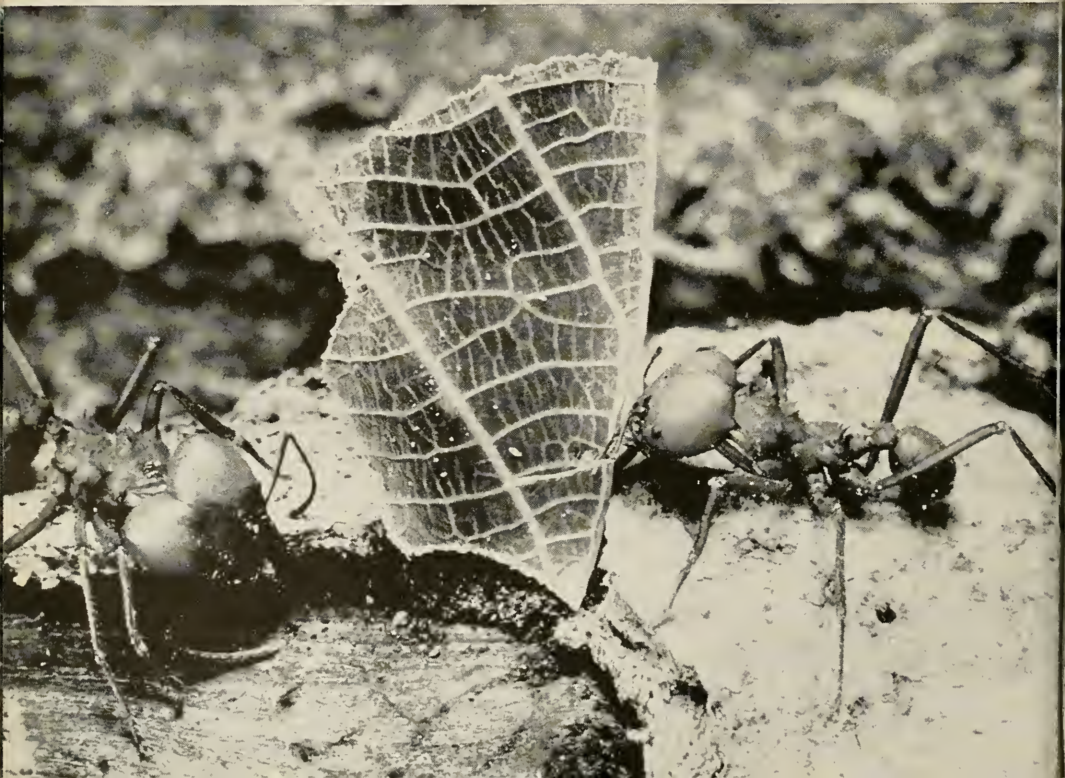
Despite their extreme aggressiveness, the Yanomamö have at least two qualities I admired. They are kind and indulgent with children and can quickly forget personal angers. (A few even treated me almost as an equal—in their culture this was a considerable concession.) But to portray them as "noble savages" would be misleading. Many of them are deightful and charming people when onfronted alone and on a personal asis, but the greater number of them re much like Padudiwä—or strive o be that way. As they frequently old me, *Yanomamö täbä waiteri!*—"Yanomamö are fierce!"

Ferocity can wear various faces. The face here, typically daubed with a paint made from chewed charcoal, is of a Yanomamö, already a killer, who is leading his raiding band through the jungle toward an enemy village.



The heavy traffic of worker ants on a trail in Brazil resembles a rushing stream of liquid chlorophyll. The ants, Atta cephlotes, *transport leaf sections to their underground gardens.*

*Below, wielding in its mandibles a leaf section much larg than itself, a worker ant of another species—*Atta texana, *th town ant—moves toward its nest. Worker at left is outboun*



Trails of the Leafcutters

These industrious ants transport vast amounts of vegetation to their subterranean gardens. They establish and maintain their impressively long roadways by laying down chemical road signs

BY JOHN C. MOSER

The trails of leaf-cutting ants are among the most conspicuous and long-lived of all ant roadways. In tropical America, where such ants are abundant, paths leading from underground nests are often a foot wide and extend for 100 yards or more to trees or other plants whose eaves the ants gather. The ants commonly carry their forage above their heads, and when the trails are in full use, parades of busy worker ants resemble running streams of chlorophyll. The ants form permanent colonies underground where they cultivate extensive fungus gardens NATURAL HISTORY, January, 1962). They use their trails constantly, for months at a time, and transport hundreds of pounds of green vegetation o their subterranean stores, thereby providing the "soil" to feed the fungus, which, in turn, feeds the ants.

The odor-trail substance, which nables the leaf-cutting ants to establish and maintain such gigantic rails, is a chemical that belongs to group of biological agents known s "pheromones." A pheromone, acording to E. O. Wilson of Harvard, s a substance that, when produced y an individual, excites behavioral r physiological changes, or both, in nother member of the same species. Dr. Wilson considers that "unlike rue hormones, which are secreted inernally to regulate the organism's wn physiology, or internal environment, pheromones are secreted xternally, and help to regulate the rganism's external environment. Moreover, pheromones may affect embers of other species, but here he term can be applied only if such gents *first* affect members of the pecies from where the chemicals riginate."

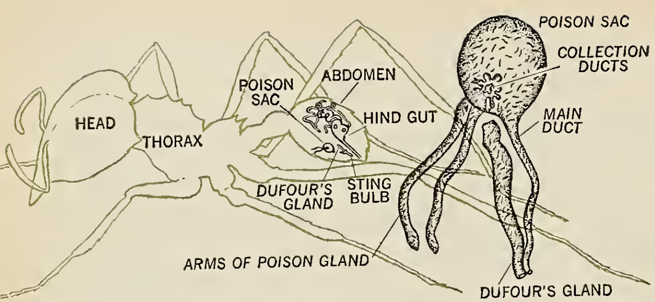
The method of chemical trail marking can be illustrated by the behavior of a laboratory colony of the town ant, *Atta texana*, at Alexandria, Louisiana, where I have been making ecological studies of this insect for the U.S. Forest Service. When a supply of green leaves is placed near a nest, scouting workers locate and examine it, and as they return to the nest they touch their abdomens to the ground and deposit the pheromone substance at regular intervals of two or three millimeters. Presently other workers follow the trail to the food supply, where they cut leaves and then carry the pieces back to the nest. The ants detect the trail by tapping the ground with their antennae, and they reinforce it by marking it frequently while carrying the forage nestward. Marking is sporadic on the outbound trip. Once a trail is well established, foragers cease touching their abdomens to the ground.

The odor substance is insoluble in water, and in the field, foraging activity continues even on wet trails and during light rains. The splashing action of a thundershower, however, temporarily disrupts the ants' efforts. At the beginning of a shower, workers moving to the foraging area quickly reverse direction and start back toward the nest. If the rain continues to be heavy, the ants simply drop their leaf sections and move to the side of the trail, there to mill about in the grass until the storm subsides to a drizzle. Then they pick up the leaves and resume one-way travel to the nest, taking alternate routes around puddles. Immediately after the rain stops, movement toward forage areas resumes.

Leaf-cutting ants, which belong to the tribe Attini, occur only in the New World and range from New Jersey to California and south to Argentina. They number about 250 species, of which about thirteen are in the United States. All Attini presumably possess the same basic odor-trail substance. In the laboratory, for example, specialized species, such as those of the genus *Atta*, readily follow trails marked by substances from the tribe's less complex genera —and vice versa. In the field, however, although the trails of various species cross, the workers generally find their own trails easily. Indeed, when I placed ants of one species on the trail of another, they wandered about until they encountered their own trail. Possibly each species produces some other chemical, in addition to the basic odor-trail substance, that attracts only members of its own species. Members of different tribes do not follow attine trail substances.

The main odor-trail pheromone is secreted by the gland that produces poisonous substances in other ant species. It is deposited by a modified stinger; that is, the mechanism probably once used by the Attini for defense or attack has evolved into a device whose sole function is communication. Most other ants of the subfamily Myrmecinae (to which the Attini belong), such as the fire ant, have retained functional stings, but these species are either scavengers or predators, and Attini are vegetarians.

The structure of the attine poison apparatus is almost identical in four representative genera that I have examined, and is evidence of a close relationship among species of the group. The odor-substance is formed in the true poison gland and is stored in the poison sac, a bladder-like structure with a crinkly surface. A tube connects this sac to the stinger; a large Dufour's gland also connects to the stinger. The Dufour's gland supplies the basic odor-substance of



In the leaf-cutting ants, the odor-trail substance is a pheromone that is produced in the poison gland and stored in the poison sac. It is deposited on the trails by a modified sting apparatus located at the tip of the abdomen.

fire ants and perhaps for attines furnishes a secondary substance that distinguishes their trails. The latter point is speculative, however, and if the secondary substance exists, it may be an anal emission.

The substance that attines lay on trails is a clear liquid that forms a milky-white suspension in acetone, alcohol, or water. When exposed to the air on a glass slide it quickly solidifies into a hard, shiny, amorphous material resembling clear fingernail polish. Only a fraction of the poison sac contents may actually constitute the odor-trail pheromone.

To test the potency of this substance, I extracted poison sacs from attines of several species, crushed each sac in one milliliter of carbon tetrachloride, and then progressively diluted the resulting solution. Smaller-sized workers—large workers are simply too excitable for tests of this kind—readily followed a circular line scribed on paper with a 1/100 dilution of the original solution, and a few of the workers could detect a 1/10,000 dilution. Sacs of large workers were obviously bigger and hence contained more odor-substance than the sacs of small workers, but the potency did not vary significantly per unit of volume. The substance is remarkably stable and persistent. Contents of *Atta texana* poison sacs crushed in carbon tetrachloride and kept at room temperature, for example, retained high potency for several months.

In the town ant, poison sacs first appear in pupae. They are empty at that stage, and when macerated in carbon tetrachloride do not attract workers on artificial trails. Sacs in young adult workers are only partially full and the contents have limited potency, but by the time the insect achieves the full red color of an adult, the sacs are full. Queens, both virgin and fertile, have a complete poison apparatus, but the sacs are always empty. Males, on the other hand, have no poison apparatus. Males and queens, however, avidly follow odor trails in the laboratory.

The genus *Atta* is the most specialized group of attines and forms the largest colonies. Main trails, a foot and sometimes more in breadth, radiate from the nest, usually branching as they approach foraging sites. In the large nests of some *Atta* species, the trails originate from "feeder holes" that form entrances to tunnels perhaps 100 yards from the central part of the colony. Thus, part of the trail is underground, usually at a depth of 1 to 1½ feet, which could help to prevent leaves from desiccating as they are carried to the fungus gardens. The tunnel-and-trail combination greatly extends the foraging range of the workers and permits the development of huge nests having 1,000 or more underground cavities, covering perhaps a half-acre on the surface and penetrating to a depth of at least 15 feet. Some one million ants may occupy a single large nest.

The foraging trails are not always busy and are not used by all ants in a nest. For example, workers of *Atta texana* in Louisiana leave their nests only when trail temperatures (not air temperatures) are between 52° and 85° F. Thus, foraging usually occurs during the day in winter and at night in summer. Species of *Atta*, unlike other attines, produce polymorphic workers—workers that vary greatly in size. The smaller workers, from two to three millimeters in length, rarely appear aboveground, as they are primarily occupied in tending the fungus gardens. Similarly, the large workers, eight to sixteen millimeters long, which seem to be the nest protectors, rarely appear on the trail. Thus the trail-making and foraging *Atta* are the medium-sized workers.

The leaf-cutting attines show preferences for certain plants as forage material. Workers in laboratory colonies of *Atta texana* like wild geranium, hackberry, sweet clover beech, and mushrooms, and they sometimes carry pine, dock, white ash, and redbud to the nests. However, they refuse lettuce, Persian clover, sycamore, and rye grass. Certain types of breakfast food—corn flakes, for example—are highly favored, even though they are dry and crisp. The ants can carry the leaflike cereal flakes easily, and they readily add them to fungus gardens—which solves the problem of providing winter forage in the laboratory if th supply of frozen leaves becomes exhausted.

In the wild the primary foraging material in winter is *Geranium carolinianum* and certain other forbs; in summer, oak, hickory, and swee gum are gathered. Pine needles, although not favored, are harvested extensively during January and February when they form the onl abundant source of green forage. O warm winter days the ants may stri the needles from pine seedlings an saplings (hence the interest of th Forest Service in this insect). Workers always cut forage at the tops o trees and work down; this habit i most evident on pines twenty t thirty feet high, the tops of whic may be clipped while the lower part are left intact. Pines over thirty fee tall are rarely attacked, even thoug their branches may touch the nes

Strictly speaking, many genera o Attini are not "leaf-cutting" ant Less specialized members of th group, such as *Cyphomyrmex*, fo age only for insect feces—caterpilla droppings, for example. In rare in stances, workers of *Atta texana* wi forage almost anything. They will cu and carry aluminum foil from di carded lunch wrappings and wi even take small stones when the trai are near gravel roads. If a cow, fo or some other animal dies on o near a nest, workers may cut an carry bits of the flesh into their nests. In laboratory colonies workers will sometimes dismember small frogs or insects and add them to the gardens. Tropical species of *Atta* use trails for the removal of leafy matter that has been depleted of nutrients by the fungus in nest gardens, piling the refuse in heaps a short distance away from nests. Colonies of *Atta texana* bury their refuse underground and use their trails only for foraging.

An unexpected discovery in the Louisiana research was that a commensal—a "guest" insect living with *Atta texana*—readily followed the ants' artificial odor trails. This was the small roach, *Attaphila fungicola*, which inhabits fungus gardens only in the nests of *Atta texana* and presumably behaves in the same way as roaches do in human habitation.

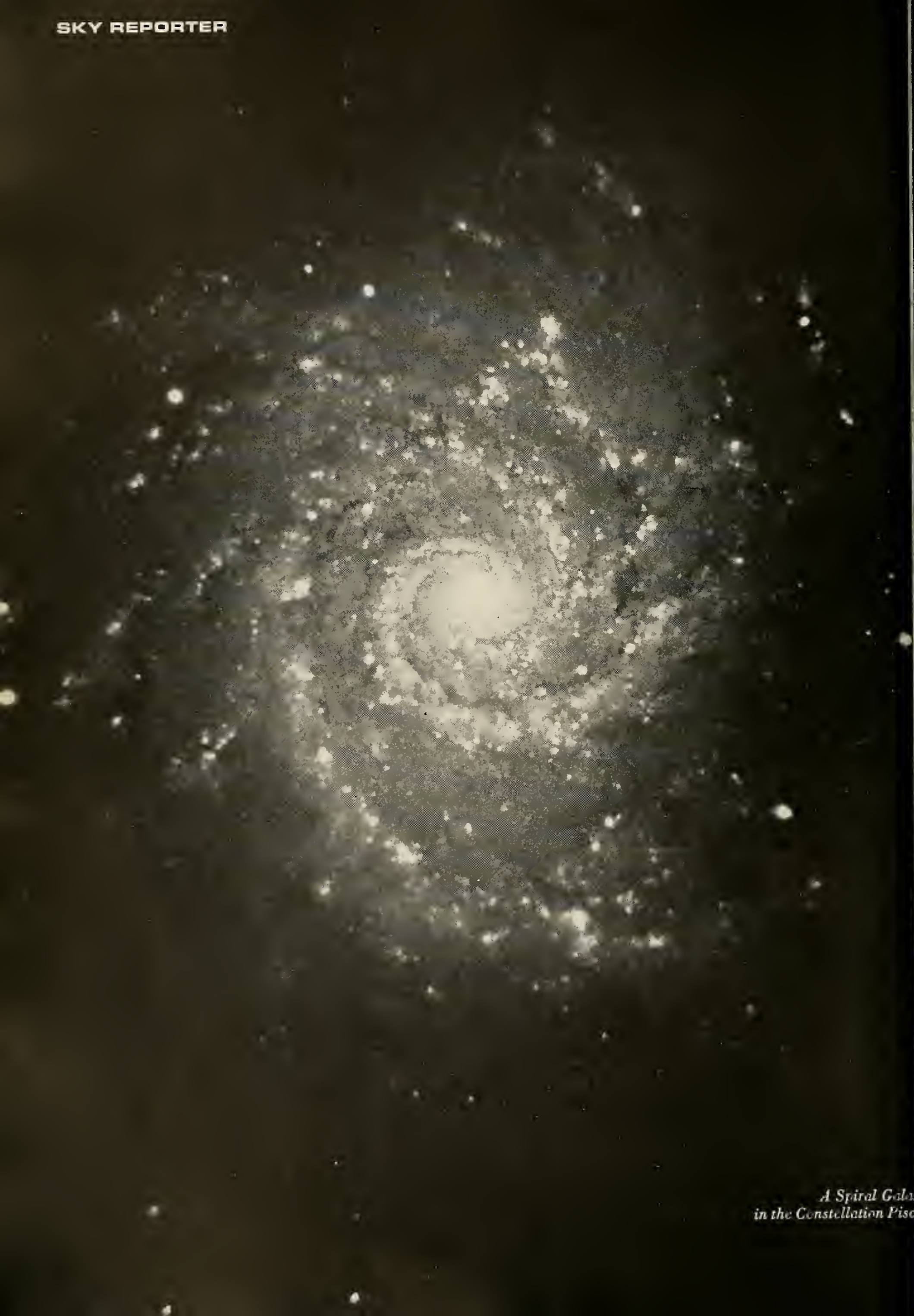
Although the roach follows artificial trails almost as readily as do the ants, this behavior has been observed only once on a field trail. In this instance, three female roaches were seen about 100 yards from an ant nest, traveling toward the nest on a trail heavily occupied by foraging workers. Since this roach species is wingless, it may use the odor-trail substance as a means of getting from one ant nest to another. More effective dispersal, however, occurs during the ant mating flights in spring, when numerous roaches attach themselves physically to queens and ride to the new nests.

Roaches are only distantly related to ants, but the ability of *Attaphila* to follow the odor-trail substance attests to its close associations with the ant, and is an excellent demonstration of how the evolution of the behavior of one animal can parallel that of another. The relationship also shows how one animal can use the pheromone of another to regulate its own behavior. It is interesting that the roach also follows artificial trails of at least one other leaf-cutting ant, *Trachymyrmex septentrionalis*, although it does not live in the nests, which are often superimposed on the larger nests of *Atta texana*. Other species of *Attaphila* do live in the nests of some South American species of *Acromyrmex*. Curiously, however, they have not been reported from nests of South American *Atta*.

Perhaps the next step in research on the attines will identify their pheromone chemically. This is a task for a biochemist, but perhaps not an extremely difficult one. Sacs from large workers of *Atta* are only slightly bigger in diameter than the period at the end of this sentence, and a skilled technician can remove them from ants at the rate of one per minute. The contents of the sac probably are a mixture of compounds, and although the amount of actual pheromone may be small, there are now models for such "eliminative" research—one of them being the successful identification of the sex-attractant pheromone of *Ips confusus*, a bark beetle found on ponderosa pine.

Leaf-cutting ants of the genera *Atta* and *Acromyrmex* are serious pests in some areas of the New World. In fact, in parts of Louisiana and Texas, *Atta texana* is responsible for killing more pine seedlings than are forest fires. In South America *Atta sexdens* must be locally exterminated before coffee and citrus crops can be grown; in Paraguay this ant has been cited as the primary reason for the poverty of many farmers. Perhaps the addition of the odor-trail pheromone to a lethal bait will aid in effectively controlling these ants where they compete economically with man.

Town ant, perhaps under the illusion that the pebble it carries is a leaf, detects the odor-trail substance by touching the trail with its antenna.



A Spiral Gala
in the Constellation Pisc

GALAXIES, QUASARS, AND THE EXPANDING UNIVERSE

by Thomas Nicholson

Most astronomers conceive of the universe as being in a state of expansion, in which all galaxies are receding from a yet-to-be-defined center. This is a relatively new idea, for before the late 1920's, astronomers were in general, if not entirely comfortable, agreement that the universe remained essentially unchanged with time. Now, however, with the discovery of those strange celestial objects known as quasars, the concept of an expanding universe is being questioned again.

The earliest references to the possibility that we live in an expanding universe are found in the theories of cosmology published by the Russian mathematician Alexandre Friedmann in 1922. In deriving models for he curvature of space, Friedmann reached the conclusion that a universe continually increasing in size with time was a mathematical possibility. His work was not generally known, however, until it was reviewed after a similar conclusion was eached independently, in 1927, by a Belgian astronomer-mathematician, Abbé G. Lemaître. Lemaître went even further and predicted that one onsequence of an expansion of the universe would be "an apparent Doppler effect" in the spectra of distant galaxies.

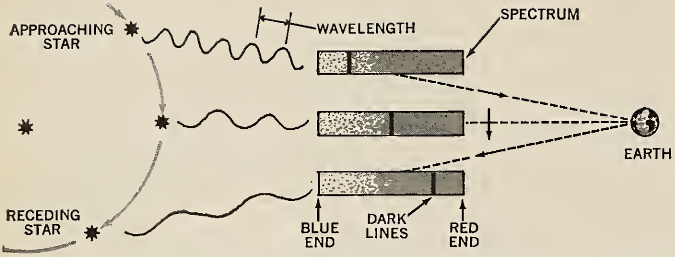
The Doppler effect is named after he German physicist Christian Doppler, who explained, in 1842, how the effect of motion could change the pitch of sound by changing the frequency of the sound waves etected by an observer. An example of this is the sudden change in the pitch of a train whistle as it approaches you and then rushes past. Doppler foresaw that the effect could also apply to light, since light behaves as wave energy in certain ways. In 1848 a French physicist, Armand Fizeau, described what the effect of motion would be on the light of a star. In the same way that the wavelength of sound determines its pitch, the wavelength of light determines its color. Although motion (of either the star or the observer) changes the wavelength of the star's light, the color of starlight is not changed because the star emits light with a wide range in wavelength. Some of the energy radiated by a star will always be observed at wavelengths appropriate to the colors seen in starlight, even though the energy may have been shifted, because of motion, from the wavelength at which it was emitted from the star.

The shift can easily be noted from observing the change in position of the dark lines (called absorption lines) in the spectrum of a star. These lines result from certain chemical elements present in stars, which absorb energy, causing dark lines to appear on the spectrum. Each of these lines represents a single wavelength or a narrow range of wavelengths, and the correct or normal wavelength at which the dark lines should be located is known from theory and laboratory experiments.

The Doppler-Fizeau principle states, therefore, that dark lines in the spectrum of a star will lie farther toward the blue end of the spectrum when the distance between the star and the observer is decreasing. If this distance, between the star and the observer, is increasing, the dark lines will lie farther toward the red end of the spectrum than their normal position. Note that the effect is caused by a continuing change in *distance*, this being the same whether the star is moving, the observer is moving, or both are moving. The amount by which the lines are displaced will be proportional to the relative velocity at which the observer and the star are approaching or separating, but—and this is important—it will also be proportional to the wavelength at which the dark line is normally located. The dark lines will be shifted in the spectrum, therefore, not by an absolute amount, but by a ratio (or percentage) of their wavelength, the exact ratio being dependent upon the rate of relative motion between the observer and the star.

Since its discovery, this principle has found wide application in astronomy, as well as in other fields of science and technology. In astronomy it can be used to measure the rotation of the earth, the rotation of a planet or the sun, the revolution of the earth around the sun, and the motions of the stars. For example, we can measure the speed of the earth's revolution by obtaining the spectrum of a suitable star at six-month intervals: when we are moving toward the star and, six months later, when we are moving away from it. If the motion of the star itself is uniform over that period of time, then we should find the lines in its spectrum displaced, over the six-month interval, by an amount proportional to the speed at which the earth travels around the sun, as shown in the illustration on page 38.

One of the most familiar applications of the Doppler-Fizeau principle on earth is the radar speed trap used on many highways. Although the en-



The Doppler Effect: As one star circles another and approaches and recedes from the earth, its velocity with respect to the earth is seen in the spectrum. The dark lines of absorption shift toward the blue end when the star is approaching us, and shift toward the red end when it recedes.

ergy used is at radio wavelengths instead of light, the principle is the same. The equipment transmits a radio signal at a fixed wavelength. When the transmitted signal is reflected from a moving automobile, the echo returns at a slightly different wavelength. The receiving equipment simply translates the wavelength of the returning echo into the speed of the automobile. If you are ever caught speeding by radar, at least you will understand how it works, although this may not be much comfort at the time.

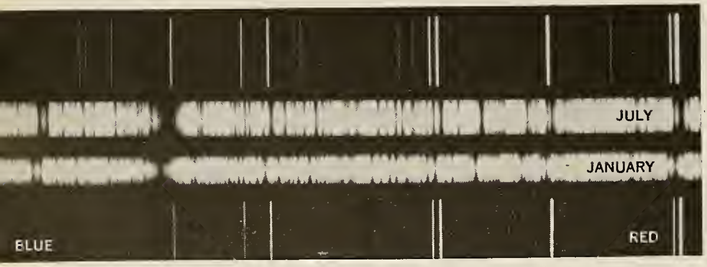
To leave the problems of the highway police and return to those of astronomers, there were, by the late 1920's, the mathematical theories of Friedmann and Lemaître in support of an expanding universe. Meanwhile, astronomers had been observing the so-called spiral nebulae for many decades. In 1924 the American astronomer Edwin P. Hubble established that the spiral nebulae were far more distant than the most remote extensions of our Galaxy, and thus they must be galaxies similar to our own. Other astronomers, however, had already observed that the spectra of these objects revealed a very peculiar feature, a systematic shift of spectral lines toward the red end of the spectrum, where wavelengths of light are longer.

Galaxies are essentially enormous condensations of stars, numbering in the hundreds of millions or billions. When the light of a galaxy is dispersed, as in passing through a prism, the resultant spectrum is similar to the spectrum of starlight. It is essentially a bright continuum, in which the light of the galaxy is spread into its various wavelengths. A few broad, dark lines appear at places, as in the spectrum of a star, identifying the absorption of energy at certain wavelengths, but the spectrum is not crossed by the many fine dark lines that appear in a stellar spectrum, because it is produced by the combined light of many stars.

The earliest reliable spectra of galaxies were obtained by the Lowell Observatory astronomer V. M. Slipher beginning in 1912. Although thi was long before their nature as galaxies had been established by Hubble, it was fairly well established that these were very distant objects so far away that they could serve a points of rest against which astronomers could measure the motion o the sun through space. In such measurements, the motion of the su should result in a systematic displacement of the dark lines in the spectra of the spiral objects by an amoun proportional to the sun's velocity But astronomers found that the line were shifted far too much, indicating an impossible velocity for the sun.

They tried, for a time, to introduce a "K-term," representing a constant velocity of recession (red shift that could be subtracted from the data, leaving the effect of the sun' motion. They found, however, tha the K-term itself seemed to vary with the objects' brightness (larger fo fainter objects) and with their apparent sizes (larger for smaller objects). This suggested to some astronomers, as early as 1918, tha the speed of the spirals might increase with their distance from us since both their brightness and size could be indicators of their distance It was pointed out, in 1922, that the spirals seemed to be receding from the sun at a velocity proportional to their distance. But this was before the distance to any of them had been determined—before, indeed, thei nature as galaxies was known. Unti these things were established, other conclusions could be taken as only tentative, at the most.

By the year 1929, some five years after he had established what they were, Hubble had determined the distances to 18 galaxies for which spectra and velocities of recession were available. In a paper published tha year, he pointed out the relation between the distance and the recession velocity for these objects, and he announced what is now known as the Hubble Law. This stated that the rec



The spectrum of Arcturus, a bright star in our spring sky, shows a Doppler shift that varies according to the earth's position in circling the sun. In July, when the earth is moving away from Arcturus, each dark line is shifted a bit to the right (toward the red end of the spectrum). In January, however, the same spectral lines are shifted to the left (toward the blue end of the spectrum), indicating that the star is approaching the earth.

Dr. Nicholson, the regular author of this feature, is also Chairman of the American Museum-Hayden Planetarium.

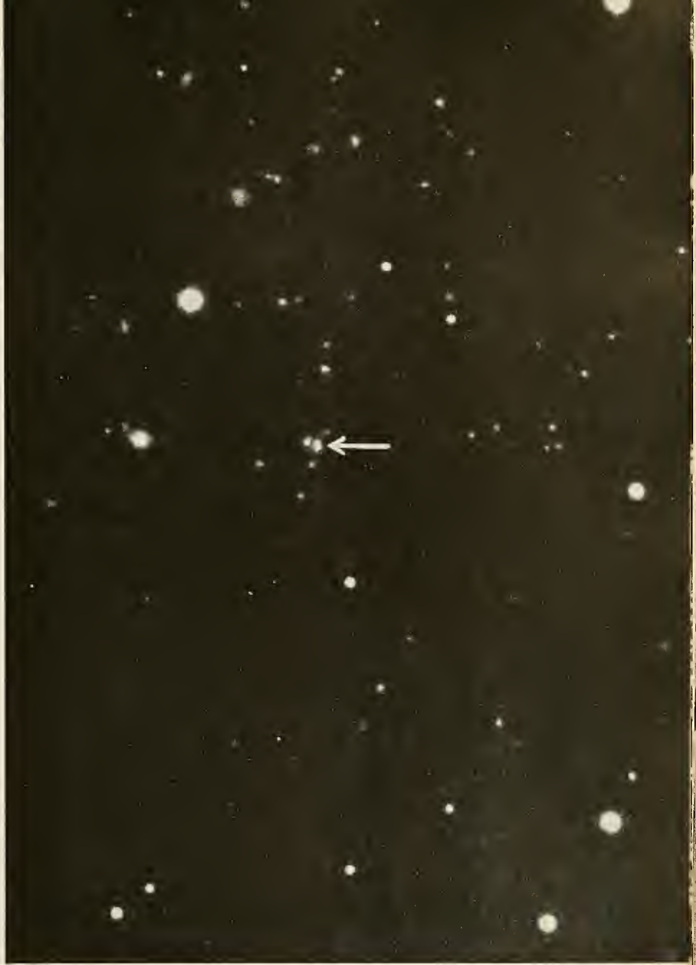
shift (indicating a velocity of recession) in the spectra of the galaxies increases uniformly with their distance. In this first statement of the relationship, Hubble gave the figure of 100 miles per second per million light-years. In other words, the spectra of the galaxies he had studied showed a red shift, indicating a velocity of recession from earth that increased by 100 miles per second for every million light-years distance to the galaxies.

In the years following the announcement of the Hubble Law, the observation of galactic spectra was pressed forward by his colleague at the Mount Wilson Observatory, M. K. Humason. By 1936 the list of objects for which recession velocities had been obtained had grown to 146, including one that exhibited a velocity of 26,000 miles per second—about 14 per cent of the velocity of light. In other words, in the spectrum of this galaxy, the dark lines were shifted toward the red end of the spectrum by about 14 per cent of their normal wavelengths.

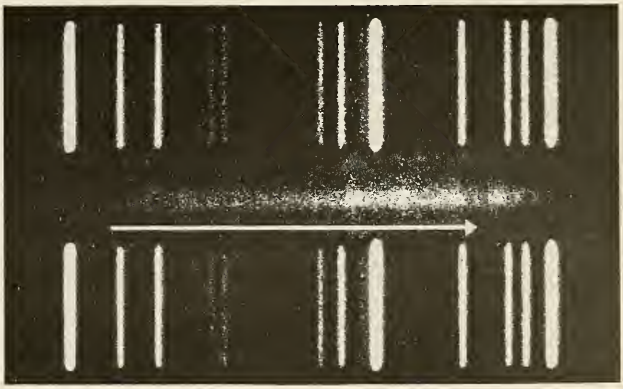
An additional 620 galaxies were included in a catalogue of red shifts published in 1956, based on work at the Mount Wilson and Palomar and the Lick Observatories. These included the largest red shift observed in a galaxy, about 38,000 miles per second, for a bright member of the distant Hydra cluster of galaxies.

The evidence seemed conclusive; the Hubble Law did seem to apply universally as far as we could observe in space. It seemed to support the concept that the universe was expanding. Then, in 1963, the first quasar was identified by Maarten Schmidt at the Mount Palomar Observatory. Since then several others of these strong sources of radio emissions have been located, and still larger red shifts have been observed for them. With these observations have come doubts concerning the validity of Hubble's Law and, thus, questions concerning the whole concept of an expanding universe. These doubts and questions will be the subject of next month's column.

The "Sky Map" is on page 67.



One of the brightest members of the faint distant cluster of galaxies in the constellation Hydra is pointed out by the arrow, above. The arrow in the spectrum, below, shows the extent of the red shift for this galaxy.



Ancient Fishes of Escuminac Bay

This famous Canadian site is unrivaled for its diverse fossil fresh-water fishes, including what may be the forerunners of the earliest amphibians

by David L. Dineley

On the northern shore of Chaleur Bay—a sharp indentation between the provinces of Quebec and New Brunswick in Canada—is Escuminac Bay. Here, between Fleurant Point and Miguasha, can be found one of the most prolific and important collecting grounds for fossil fishes in North America. Formed about 360 million years ago in the Late Devonian, the Escuminac Formation is comprised of gray shale and sandstone some 400 feet thick, and the fossils of the Escuminac Beds afford an unusually complete view of a unique Late Devonian fresh-water lake fauna. Not only are there large numbers of fishes in a fine state of preservation but the rather unexpected assemblage includes what may be the forerunners of the amphibians. These fossils first attracted attention nearly 100 years ago, and since the 1880's more than 70 scientific accounts have dealt with them in one way or another.

The gray cliffs that rim the bay make an impressive southward-facing sweep almost a mile and a half long. A constant supply of new blocks and boulders falls to the beach as the cliffs above are eroded by winter and spring tides and storms. Some of the best fossils are found in these blocks, encased in gray, silty shales or in large, flat, or bun-shaped nodules. Plants, as well as fish armor and scales, are often beautifully preserved in the rock, and traces of the soft parts of one of the fishes have been found. The absence of any sort of marine fossil confirms that we are dealing with the deposits of a fresh-water lake or river flood plain. They are comparable to fossils found in Late Devonian Old Red Sandstone deposits in Britain, the Baltic countries, and Greenland, all of which are also apparently fresh-water types.

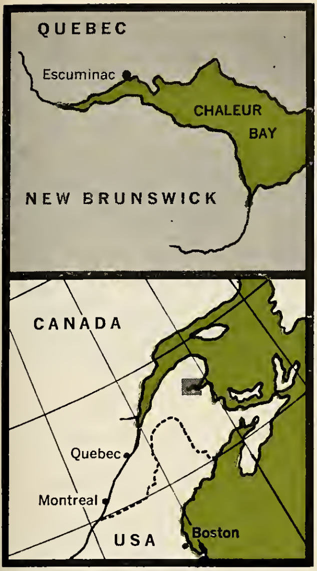
Near the top of the formation lie some thick, coarse sandstones containing masses of mud pebbles or shale flakes (torn up from a dried watercourse) and broken fossil fish remains. These are indications of sudden violent floods that flushed out part of the local river system and deposited its detritus in the quieter waters of the Escuminac Bay area. We have no firm idea of the size of this lake, where the waters that fed it came from, or where it drained. There was certainly land vegetation, reflecting climatic conditions that were reasonably humid.

Earth movements and erosion have obscured much of the story, but what remains tells a great deal about some of the earliest fishes to possess lungs as well as gills. Many specimens show us delicate scales and tiny bones still in place. From their appearance, the fishes died quietly, and perhaps quickly, in waters where mud and other sediment soon engulfed the bodies. Scavengers seem to have left the corpses alone, for the most part. Many of the lungfishes and the active swimmers are found lying on one side, and if the embedding rock is split open the fish fossils are also neatly split down the middle, so that bones and scales are all revealed. The flesh, of course, leaves no trace, but the scales are often preserved and, in a split specimen, are seen "from the inside."

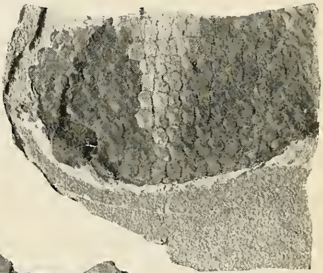
Two of the Escuminac fishes were apparently among the last of the ostracoderms—armor-plated, jawless, little animals that lived before and during Early Devonian times, up to about 400 million years ago (NATURAL HISTORY, August-September. 1964). Few ostracoderms are known from younger, more recent rocks, and the group may have no descendants today, although the modern lampreys and hagfishes are held by some scientists to be their distant relatives. Thus, the Escuminac specimens from the Late Devonian come as a surprise.

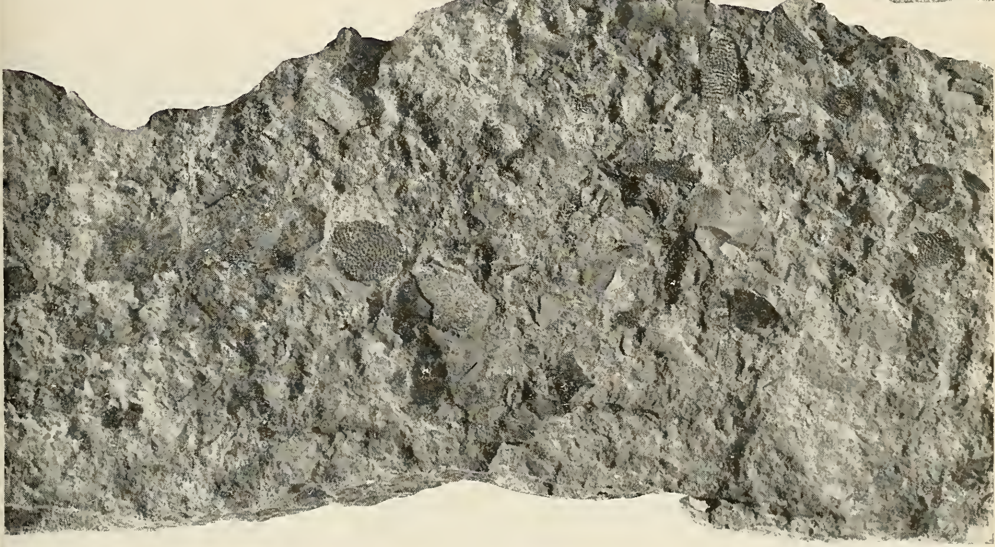
One of their kind (the cephalaspids) was about ten inches long, with a spade-shaped, flattened, bony head shield and a scaled body. Because the mouths were on the flat underside of the head, and there were no pelvic fins, we know they were certainly bottom-dwellers. Lacking jaws, they existed on a diet of small particles of food, perhaps algae and minute animals sucked off the bottom. Cephalaspid ostracoderms are well known in Early Devonian and older rocks in other parts of North America and Europe, but from younger strata very little material has been collected. The evidence appears to point to their decline sometime during the Devonian Period. It is frustrating not to have more material from the Escuminac Bay area, but it is probable that these animals had become something of a rarity in the lake fauna.

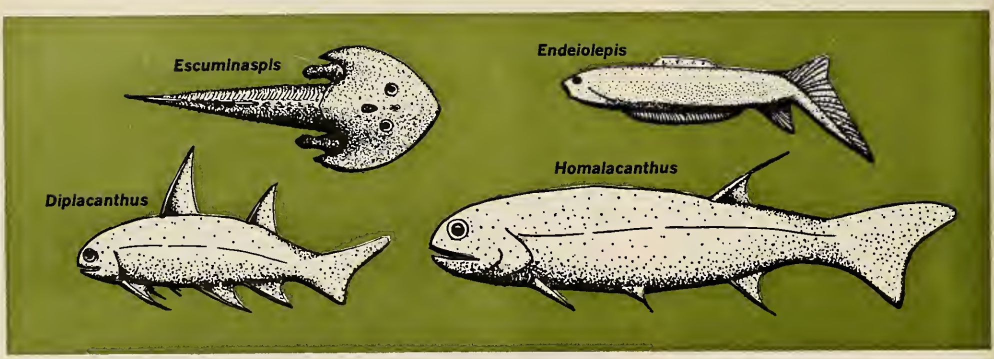
There are also two species of another rare, ancient, and primitive group of ostracoderms, the anaspids. These were minnow-sized and minnow-shaped little fishes, covered with a fine mosaic of bony plates and scales. They probably had small, sucker-like mouths, prominent eyes, and a diagonal line of gill holes along the side of the head. So far no anaspid head has been found here, or at least none has been reported. Like modern lampreys and hagfishes, the anaspids had only one nostril. Hagfishes today seem to have a strong


QUEBEC
Escuminac
CHALEUR BAY
NEW BRUNSWICK
CANADA
Quebec
Montreal
USA
Boston

Most of the best fossil material in the Escuminac Formation comes from the sandstone layers and nodules at the foot of the cliffs. The scales of one of the larger bony fishes are at right; they are of bony tissue with an outer coating of shiny enamel. Light part is where organic tissue was replaced by iron pyrite. Below, a piece of coarse sandstone contains crinkly fragments of plates of an armored fish, Bothriolepis, *as well as pieces of other fishes and plants. Fish remains may be the result of a flash flood that swept a dry flood plain where fish had become stranded.*







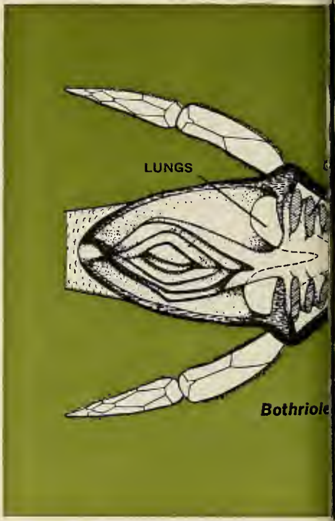
At top are two jawless, armored fish that were quite rare. They probably sucked food from the lake floor. At bottom are two representatives of the acanthodians. These were active swimmers, with functional jaws and teeth.

sense of smell by which they locate their food—corpses of fish or other animals lying on the sea floor. The anaspids may have been similar in habit. It has also been suggested that they fed in an almost vertical, tail-up position, sucking food from the lake floor. One scholar, however, has thought that these animals so resemble modern lampreys that they may even have had the rasping tongue and parasitic habits of that animal, but the evidence for this is tenuous. To judge from the number of fossils found so far, the anaspids were not prolific. As far as we know, these anaspids, like the cephalaspids, were the last of their kind.

Another group of small fish present was the acanthodians, although they are not common fossils. They were cigar-shaped creatures only three or four inches long, with each fin supported by a bony spine along the leading edge. The body was covered with a coat of tiny, lozenge-shaped bony scales. Acanthodians had large eyes placed well forward on the head. In many of the acanthodians the teeth were mere conical bony projections from the jawbones. No doubt these fish were active swimmers, able to pursue smaller creatures for food. The first-known acanthodians appeared in Silurian times and the last occur in the Permian—a history of some 170 million years. They are known in marine deposits and in fresh-water beds; thus, altogether the acanthodians seem to have been a successful group.

The other animals present in the lake included a large number of the varied, extinct group known as placoderms ("plate-skinned"). Most, although not all of these, had head and shoulders encased in armor, possessed primitive jaws, and had some kind of paired fins. The biggest placoderms were the arthrodires, predators known by their large jaws and the conspicuous joint between head plates and shoulder armor. At Escuminac, *Plourdosteus* was one of these. This fish, some thirty inches long, had a blunt head and shoulder regions enclosed in stout armor, while the spindle-shaped body appears to have lacked plating. The head of this creature seems to have been jointed to the shoulder in such a way as to allow the whole of the skull to rise as the lower jaw dropped. In this way its mouth had an enormous gape, so the fish could seize relatively large prey. The jaws were not lined with true teeth, but had bony projections that may have been used for cracking bony armor and shearing flesh. *Plourdosteus* had large eyes and was, we think, an active carnivore ready to snap at anything moving. Other species of *Plourdosteus* occur in the Baltic Old Red Sandstone.

Very different placoderms were the antiarchs, which had a solid box of head and body armor and a pair of remarkable boneplate-encased fins, or "flippers." Perhaps the most abundant and famous remains at Escuminac Bay are one species of antiarch called *Bothriolepis*. Behind its armored parts, a

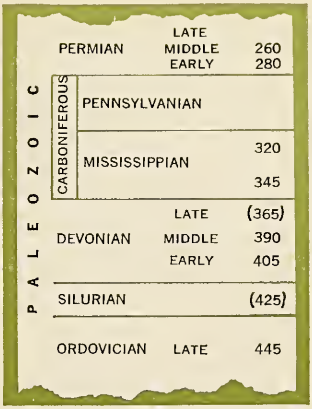


Perhaps the most abundant remains at Escuminac Bay are of Bothriolepis, *a 15-inch fish with four pairs of primitive gills, plus "lungs," as shown in the diagram. The head and foreparts were armored, as were the two flipper-like appendages, which most likely served the animal as sculling oars.* Plourdosteus *was a 30-inch predator whose heavily plated head and shoulders were jointed, allowing the whole skull to rise as the lower jaw dropped. Its mouth thus had an enormous gape that permitted this fish to seize relatively large prey.*

tapering body and long, low, apparently scaleless tail gave the fully grown creatures a length of up to fifteen inches.

This fish had nostrils, and its small eyes were placed close together near the top of the head. Between the eyes was a small pineal opening, a light-sensitive spot found in other primitive vertebrates. On the sides of the head were small, movable plates, which covered the gill channels. Similar plates occur in other antiarchs. and we think that fishlike respiratory movements took place; that is, gulped-in water passed through the gill cavities and was then pumped out rhythmically from under the gill covers.

Flipper-like appendages were joined to the sides of the body shield by an ingenious joint and were also hinged in the middle. The musculature of the appendages bore a striking resemblance to that of the limb of an arthropod (such as a beetle or crustacean)—a feature seen in no other group of vertebrates. All this gave a considerable range of up-and-down movement and some sideways movement, as well. We know also that the flippers could be twisted on a ball-and-socket joint so that the broad plane may have been almost vertical for a swimming stroke and then brought forward horizontally and flat for the least possible water resistance. In fact, it was probably used rather like a sculling oar.



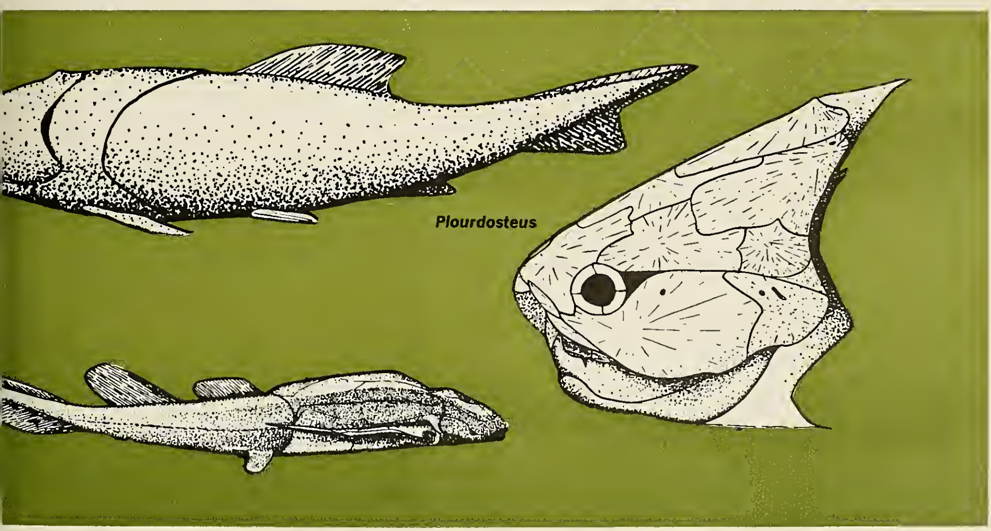
PALEOZOIC	PERMIAN		LATE	
			MIDDLE	260
			EARLY	280
	CARBONIFEROUS	PENNSYLVANIAN		
		MISSISSIPPIAN		320
				345
	DEVONIAN		LATE	(365)
			MIDDLE	390
			EARLY	405
	SILURIAN			(425)
	ORDOVICIAN		LATE	445

The Escuminac Formation was formed in Late Devonian. Beginning of intervals is shown in millions of years.

A rare and important find some years ago has enabled Dr. R. H. Denison of the Field Museum of Natural History to describe some of the internal anatomy of *Bothriolepis*. Large, primitive gills well up in the front of the body and a pair of ventral lungs were indicated, as illustrated in the diagram on these pages. The soft tissues were preserved as carbonaceous films in the sediment. The hollow organs were completely mud filled, and by sectioning the fossils, Denison was able to reconstruct a primitive, straight, and uncoiled gut with a complex, spiral valve, such as is found in sharks.

In addition to these archaic fish types, the Escuminac Beds contain several more advanced and equally fascinating creatures. They are all members of the Osteichthyes, the true bony fishes, of which there are two well-known major divisions—the rayfins and the lobefins. They first arrived on the scene in Middle and Early Devonian times, respectively, some 20 million years or more before Late Devonian times.

The Escuminac fauna includes a single species of rayfin—a rare fish known as *Cheirolepis*. It was about ten inches long, blunt-nosed and torpedo-shaped, with the heterocercal tail (the upper lobe larger than the lower) also seen in sharks. It had two large, low-set eyes and long jaws lined with small, sharp teeth. The body was covered with a layer of small, thick, almost square scales with shiny dentine on the outer surfaces. It is probable that the fish possessed the primitive lungs that in later fishes became transformed into the air, or swim, bladder. In many ways, it is said, the Canadian species of *Cheirolepis* closely resembles the only other known species, which oc-



curs in Scotland. Both seem to belong to the ancestral stock from which ray-finned fishes (as distinct from sharks and rays) developed.

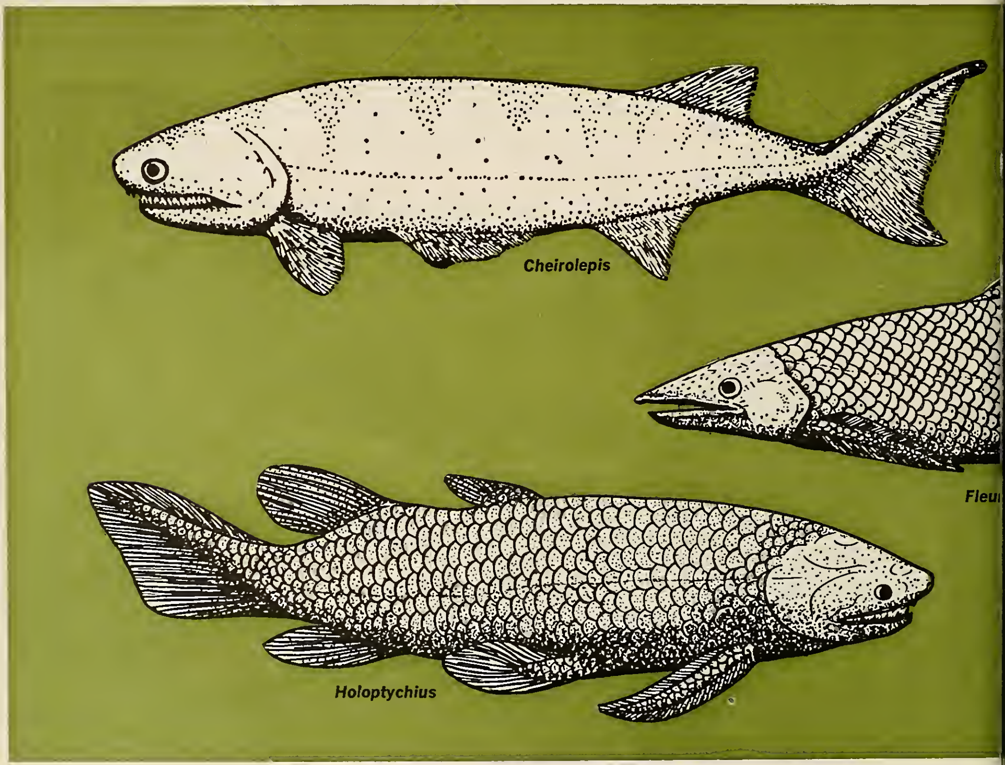
The comparatively modern-looking lobefin, or crossopterygian, fishes were well represented in the Escuminac waters by several species. One of their most interesting and characteristic features is the internal structure of the paired fins—a basic pattern from which the tetrapod limbs may have developed.

Of these lobefins, *Eusthenopteron* has become the most famous, because it lies close to the main ancestral line of the tetrapods. It was a strong, cigar-shaped fish covered with thick, bony scales. The skull was made up of relatively large, strong bones and powerful jaws. The several rows of small, sharp teeth show a remarkable similarity to those of the early amphibians. When *Eusthenopteron* snapped at its (perhaps armored) prey, the unusual skull structure may have served as a shock-absorbing mechanism or increased the force of the bite.

The less well-known and somewhat different lobefins *Glyptolepis* and *Holoptychius* are most often represented by isolated scales or patches of scales, but some complete specimens have been found. They were relatively plump fishes some twelve to fifteen inches in length. Their rounded and overlapped scales had a distinctive ornamentation of fine ridges and tubercles. Like others in the group, they had powerful jaws with sharp teeth and, clearly, they were carnivores.

Two genera of lungfish, or dipnoans, occur in the Escuminac fauna and have not been found elsewhere. Lungfishes are a well-known group that has had a long, slow evolution. Appearing first in Early Devonian times, they occupied both marine and fresh-water environments in the Middle and Late Devonian. After this, they were largely, if not entirely, restricted to fresh waters.

Each of the Escuminac lungfish was about six to eight inches long with a pointed head, stout body, and tapering, upward-tilted tail. Paired fins spring from the body on scaled, muscular stems, like those of typical lobe-finned fish. The eyes were large and the jaws were armed with small, but effective, teeth. It seems probable that, like modern lungfish, these animals had functional lungs and could



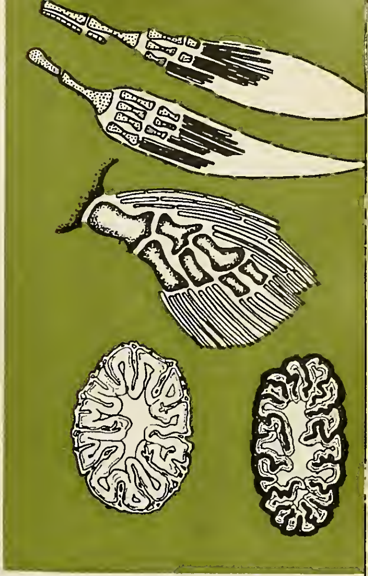
The Escuminac Beds have several more advanced creatures, early members of the true bony fishes. Cheirolepis *is the only example of the rayfins. The rest are lobefins, and of these* Fleurantia *and* Scaumenacia *are lungfish that could probably withstand long periods of foul water or drought.* Eusthenopteron *is a lobefin that could possibly make its way from one body of water to another, representing an early step on the way to amphibians.*

withstand periods of foul water or drought. They have, over the millenniums, largely lost their ability to form hard bones, but they retain a cartilaginous skeleton. In addition, lungfish today are probably slower moving and more sluggish than those that lived in Devonian times, because they no longer possess separate unpaired fins.

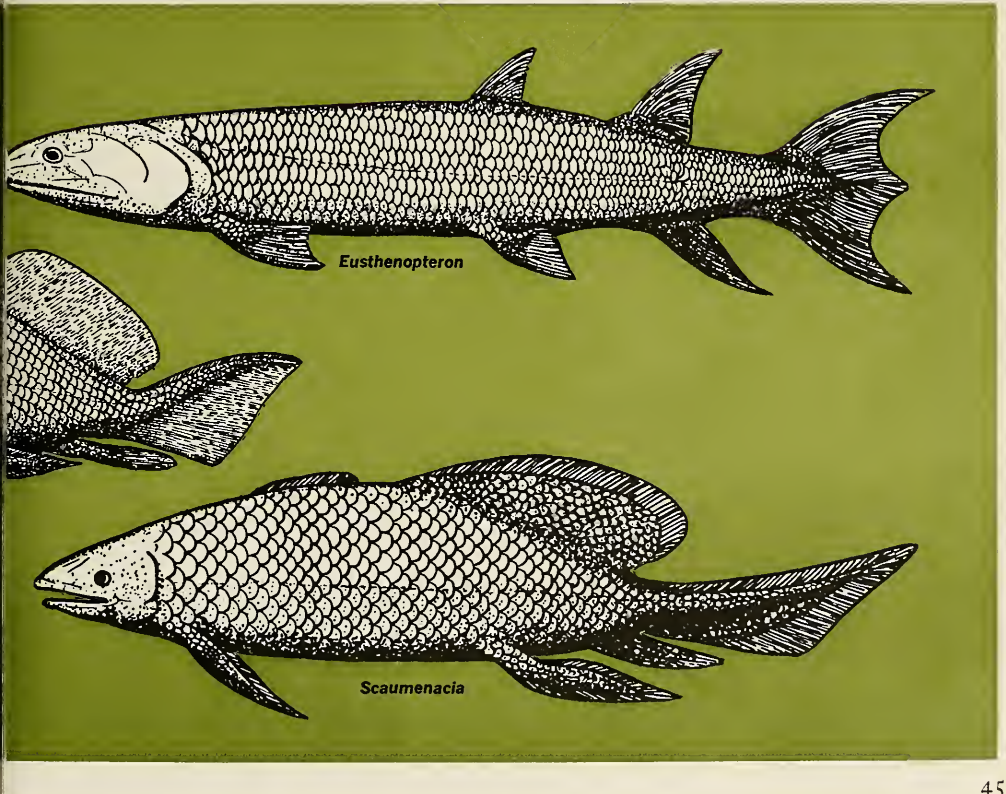
Most modern lungfishes are also characterized by the lack of teeth at the edges of the jaws and by a few broad, flat, crushing teeth over the mouth floor and roof. One of the Escuminac genera, *Scaumenacia*, had this kind of dental pattern, but the other, *Fleurantia*, possessed rows of sharp, compressed teeth for shearing and piercing. In another way, too, the latter fish was unusual: its long snout and general construction suggest that it was capable of catching fast-swimming food. The lungfishes may have been omnivorous, also feeding on soft-bodied invertebrates or plants.

As Professor A. S. Romer of Harvard's Museum of Comparative Zoology has noted, in any good sample of the "catch" from the Escuminac Beds, over 95 per cent of the specimens consist of lungfishes, lobefins, and rayfins. It is interesting to see such a diverse collection of aquatic animals equipped with lungs, the means of surviving drought or foul-water conditions. Indeed, lobe-finned fishes and lungfish could possibly make their way from one body of water to another across mud flats or dry land. Professor Romer and Professor E. Jarvik of Sweden have each described what an important step (literally!) this was in the evolution of vertebrates. It was the beginning of the development of legs.

There are few other sites where we find comparable Late Devonian conditions and faunas. None matches that at Escuminac in its preservation of so remarkable and varied a group of aquatic animals.



Skeletal patterns in fins, top, anticipate those in amphibian limbs. Bottom shows similar cross sections of lobefin (left) and amphibian teeth.



by CHRISTOPHER J.
SCHUBERTH

The Hudson's Six Geologies

Many rivers are much longer. But few can match the story we read in the terrain traversed by this picturesque 300-mile link between the lonely lake called Tear of the Clouds and the bustling island called Manhattan

Henry Hudson exulted as he sailed the *Half Moon* past the tranquil, green island shore of what is now the heart of New York City. In finding this waterway the English navigator was entirely certain that he had also discovered the long-sought Northwest Passage to the fabulous, exotic lands of the Far and Middle East. His employer, the Dutch East India Company, would reward him bountifully.

The inevitable rude awakening did not come until the island of Manhattan was far astern, until Hudson noted the lessening tides and fresher water near the present site of Albany. Just another river! So he turned back. That was in 1609.

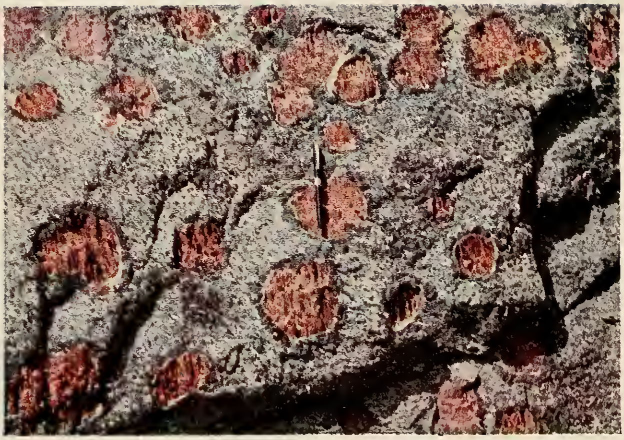
But discovering this river that was to bear his name was hardly trivial. The Hudson became an important corridor of history, and today it remains very much in the news. For instance, it is a focus of national concern over the proper care of our rivers; this vital part of New York State's massive program for controlling water pollution will be a bellwether for similar programs throughout the nation. Meanwhile, bitter controversy clouds a power company's proposal to build a huge hydroelectric plant along the river's west shore at the foot of Storm King Mountain, a major peak in the picturesque Hudson Highlands. The fate of this project will significantly affect the future of many still relatively unspoiled areas along our major waterways.

But the Hudson offers more than a dramatic controversy; more, too, than a series of remarkably beautiful and varied landscapes. There are few rivers in North America that we find traversing a terrain of such geologic diversity and complexity in such a short length (the United States alone has more than sixty other rivers that travel farther than the Hudson). Yet in its course of three hundred miles the Hudson flows through five distinct geologic regions and past a sixth.

Cartographers place its source at a point about 3½ miles north of the village of Tahawus, N.Y., in the High Peaks region of the Adirondack Mountains. There, about 1,800 feet above sea level, the courses of Indian Pass Brook and Calamity Brook join into one stream, the Hudson River. But if the highest body of water feeding a river is considered its true head, then one must follow the east fork, Calamity Brook, which leads to Lake Colden, perched in the more remote portions of the Adirondacks. But continue. Opalescent Brook, tributary to Lake Colden and Calamity Brook, fingers its way still higher into the thick, evergreen-covered slopes of the High Peaks. Finally, Feldspar Brook, tributary to Opalescent, reaches into a small body of water that is a blue-green gem called Lake Tear of the Clouds, 4,322 feet above sea level. Recognized as the ultimate source of the Hudson, it nestles in a basin on the southwest flank of New York's highest peak, 5,344 foot Mount Marcy.

In its passage through the Adirondacks, the Hudson flows over some of the oldest rock in North America. The Adirondacks are the southernmost extension of the Canadian Shield—a broad region of primarily metamorphic rock dating back to Precambrian times of more than 1,100 million years ago. In those times, various kinds of igneous rock deep under the surface of the earth

Sparkling, gay Feldspar Brook tumbles out of nearby Lake Tear of the Clouds on its way to become the Hudson River.

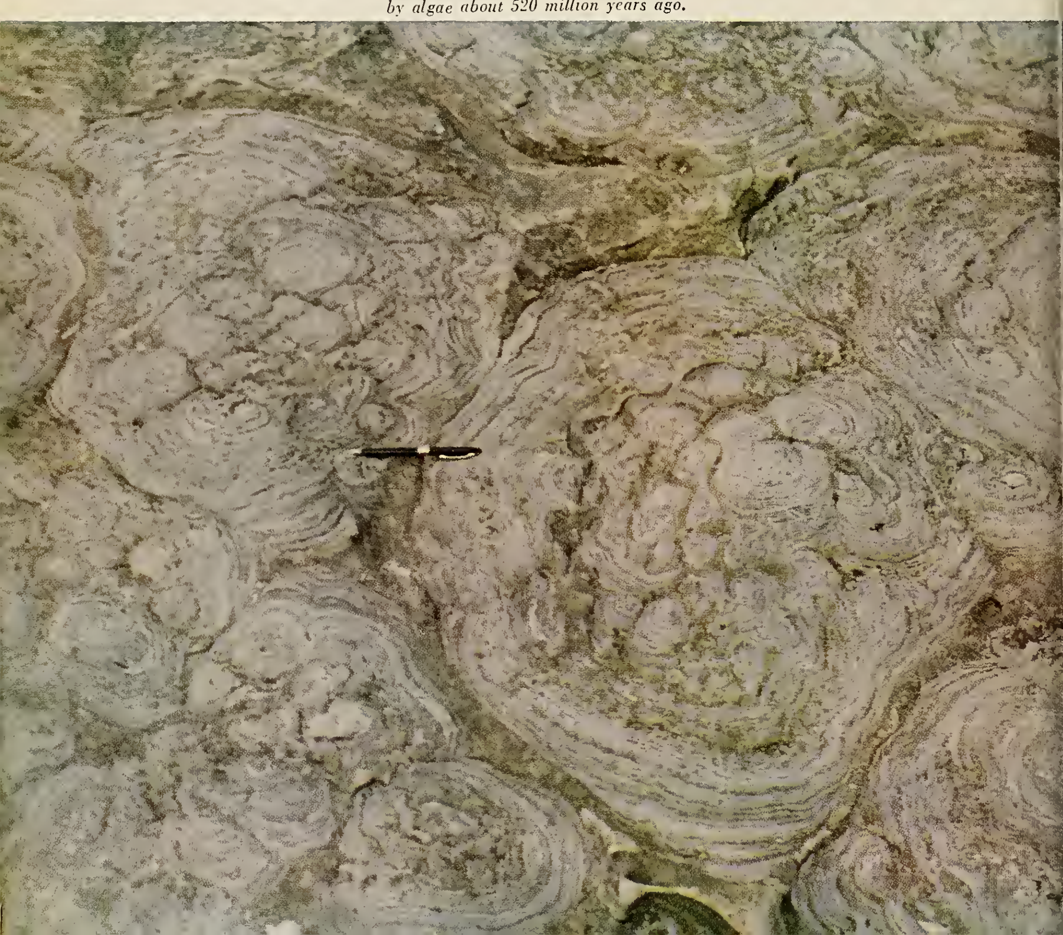


Above, large garnets (pen shows their size) enrich Precambrian rock at Gore Mountain in Adirondacks. Mineral is quarried for use as natural abrasive.

Below, evidence that Saratoga Springs was once part of an intertidal zone: cabbage-like structures were built up by algae about 520 million years ago.

were subjected to enormous pressures and intense heat. Subsequent crustal uplift brought these metamorphosed rocks to the surface. There, over vast periods of time, they were eroded by wind and weather and, more recently, gouged and scarred by glaciers, producing the wild and rugged landscape that persists today.

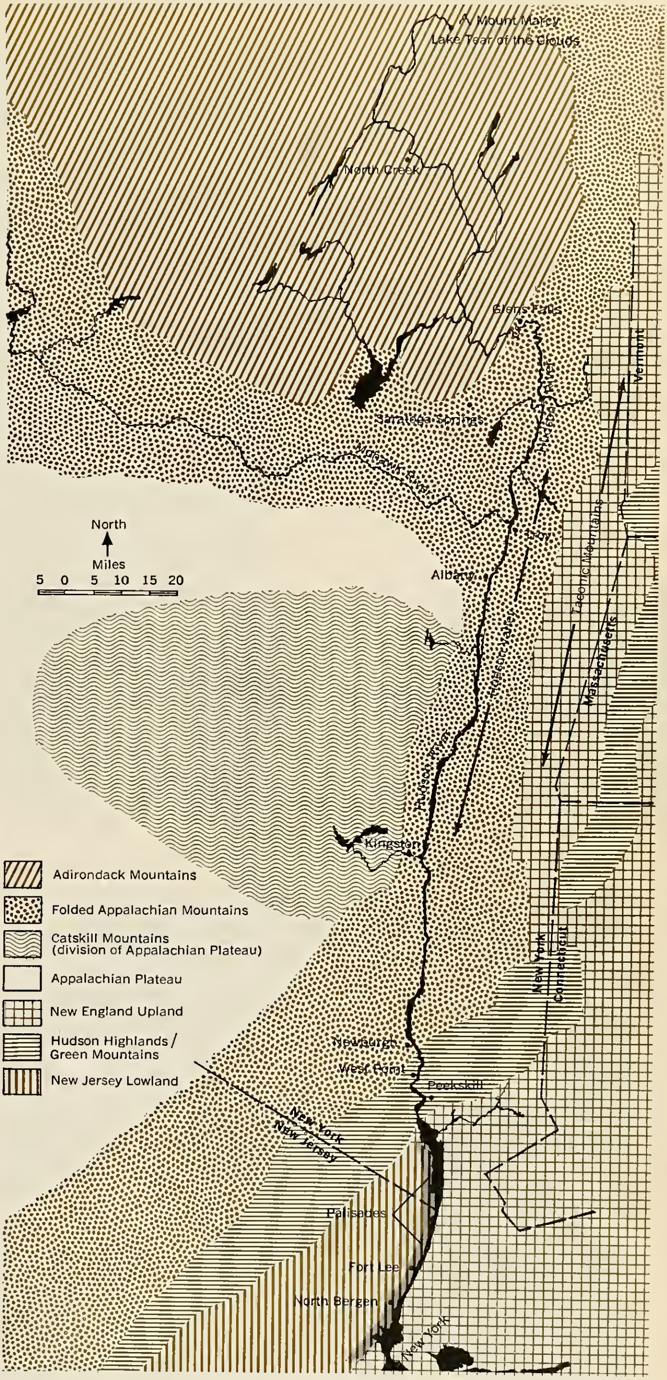
When examining the bedrock of the Adirondacks, it is evident that metamorphic rock predominates. A mountainous core about 100 miles in diameter appears to have been, before metamorphism, of igneous origin. This type largely forms the bedrock of the High Peaks region. Noteworthy is an extensive body of anorthosite that also occurs here. Measuring 40 to 50 miles across and covering more than 1.200 square miles. this massive rock type underlies Mount Marcy, Mount Whiteface,



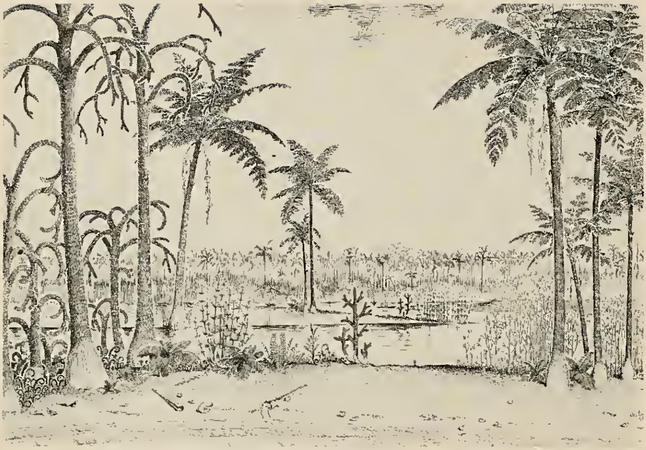
and other outstanding summits of the High Peaks. Plagioclase feldspar, such as the strikingly beautiful variety called labradorite (*see* NATURAL HISTORY, October, 1965), is its essential mineral component, although anorthosite may include minor amounts of other minerals such as garnet, hornblende, ilmenite, magnetite, and apatite.

The actual origin of many of the rock types in the Adirondacks is still a matter of considerable conjecture. This problem is not unique; it applies to all terrains where deep-seated regional metamorphism was in effect during the long Precambrian history. Often, important economic mineral deposits develop in such bedrock, and it is not unusual for such rock to exhibit some unique features. An example is Gore Mountain, on the west shore of the Hudson River near North Creek, which contains one of the largest garnet deposits in the world. Because of its physical properties, the mineral garnet is valuable as a high-grade, natural abrasive. At the Barton Mines, the garnet crystals average four to five inches in diameter. Frequently, the open-pit digging has brought up crystals of the semiprecious red type measuring three feet in diameter. Surrounding the large garnet crystals, called porphyroblasts, is a distinct rim of either hornblende or plagioclase feldspar. Although the rock with its garnet content is the product of metamorphism, the nature and the times of the metamorphic events are still controversial.

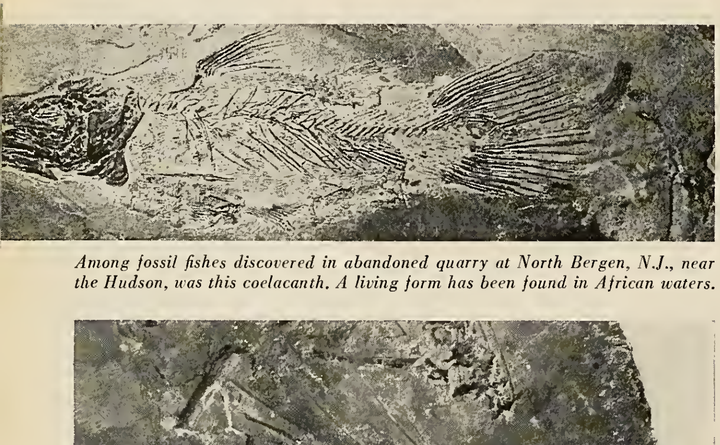
Continuing south along the Hudson, the complex Precambrian geology of the Adirondacks is left behind at Glens Falls. Now comes a noticeable change in the terrain through which the Hudson flows: the lower, gentler hills of the second geologic province—the Folded Appalachian Mountains (called in this region the Hudson or Great Valley). Much narrower in the Hudson Valley than their extension farther south in Pennsylvania, West Virginia, Tennessee, northeastern Alabama, and northwestern Georgia, the Folded Appalachians are underlain by folded and faulted (fractured) marine sedimentary rock of Early Paleozoic times—which ranges from


Mount Marcy
Lake Tear of the Clouds
North Creek
Glens Falls
Saratoga Springs
Mohawk River
Hudson River
Vermont
Troy
Albany
Taconic Mountains
Hudson Valley
Massachusetts
North
Miles
5 0 5 10 15 20
Hudson River
Kingston
Adirondack Mountains
Folded Appalachian Mountains
Catskill Mountains (division of Appalachian Plateau)
Appalachian Plateau
New England Upland
Hudson Highlands / Green Mountains
New Jersey Lowland
New York
Connecticut
Newburgh
West Point
Peekskill
New York
New Jersey
Palisades
Fort Lee
North Bergen
New York

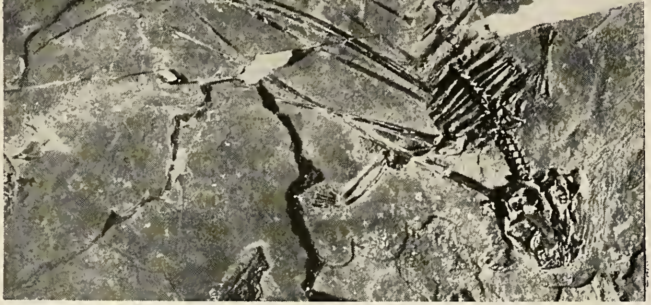
Course of the Hudson, from its source on a flank of Mount Marcy to its end at New York City. South of Albany, ocean tides make it "the river that flows in two ways."



Treelike ferns (above) thrived over 370 million years ago in swampy lands that later became the Catskills, one of the noted geologic areas along the river's course between Albany and New York City. At right is another—the Hudson Highlands. Its panoramic sweep is shown eastward across the gorge.



Among fossil fishes discovered in abandoned quarry at North Bergen, N.J., near the Hudson, was this coelacanth. A living form has been found in African waters.



From the same New Jersey Lowland quarry were recovered the remains of a unique winged reptile. It was named after one of the three schoolboys who found it.

600 million to 400 million years ago.

Here, unique to the resort town of Saratoga Springs, twelve miles west of the Hudson's shores and renowned for its mineral springs, is evidence that at one time the now gently rolling hills were apparently an isolated part of an intertidal zone. With no outlet to the ocean, this basin developed a salinity somewhat higher than the open sea. Saratoga's reef limestones, known as stromatolites (layer stones), are a graphic reminder of these ancient times. Constructed almost solely by certain colonial algae, the stromatolites resemble fossil cabbages or large Brussels sprouts. Since glacial erosion has planed these reefs, the algal heads, two feet or more in diameter, are magnificently displayed in horizontal sections. On the other hand, vertical joints (fissures) in the limestone reveal them in cross section.

Stromatolites are still being formed by algae in some present-day lakes and seas. By comparing the fossil versions with modern forms, it appears that they are the work of simple blue-green algae (cyanophytes), which live in chains or mats and hold themselves together with a jelly-like substance, on which a pre

cipitate of calcium carbonate settles. In this way the organisms build stony replicas of their colonies. As successive colonies are buried, new ones are continuously formed. In this manner great reeflike replicas of the colonies have become preserved in the rock record.

It is also notable that although the stromatolite *Cryptozoon proliferum* at Saratoga Springs is only of Late Cambrian age (about 520 mil-ion years old), other stromatolites occurring elsewhere in North Amer-ca come very close to representing he earth's oldest remains—some 2,000 millions years old. So here, not ar from the west shore of the Hudson River, we discover a preserved example of what biologists and paleontologists consider to be one of the original forms of life on our young planet of two billion years ago.

About 20 miles south of Saratoga Springs, and now about 160 miles below Lake Tear of the Clouds, the Hudson River formally loses its in-ependence. Here, beginning at the ity of Troy and for the remaining 50 miles to its mouth, the Hudson s an inlet of the sea—an estuary. This fact is not a discovery of modern science. The Algonkin Indians, realizing that ocean tides were sweeping up and down the broad valley, described the Hudson as "the river that flows in two ways." Oceangoing vessels that ply the estuary's 32-foot-deep channel and dock as far north as Albany rise and fall on a 4½-foot tide. It is small wonder that Henry Hudson thought the Northwest Passage was at last a reality.

A few miles southwest of Albany the waters of the Hudson glide past the historic and statuesque Catskills. It was in these rolling mountains immediately west of the Hudson Valley that Washington Irving's mythical Rip Van Winkle met the ghosts of Henry Hudson's legendary crew in "old Dutch dresses playing at nine-pins in the hollow of the mountains . . . the sounds of their balls like distant peals of thunder." In 1860, about two hundred years after Rip's return to his home town, a severe thunderstorm sent waters racing down the upper valley of Schoharie Creek, which flows from the Catskills northward into the Mohawk River, an important tributary of the Hudson. The flash flood not only washed out bridges, roadbeds, and culverts, it also exposed for the first time some strikingly distinctive fossils near the little village of Gilboa. Paleontologists soon recognized these as the stumps of tree ferns similar to those that grow in the tropics today. The sedimentary strata in which these fossil stumps occurred are of the Devonian Period, some 370 million years ago. This was an exciting discovery—never before had rocks of such vintage shown evidence of recognizable trees.

Then, in 1920, during excavations by the New York City Board of Water Supply for the Gilboa Reservoir Dam, several hundred additional stumps, trunks, and even fronds of the same tree fern were uncovered. Evidently these were the remains of a forest that is still the oldest ever discovered. It seems to have consisted of a single kind of tree, known as *Aneurophyton*. The tree had a straight trunk twenty to forty feet high; a swollen, onion-shaped base three to four feet thick; and a crown of large, drooping, fernlike fronds surmounting the unbranched trunk. It probably grew in swampy areas and was reproduced by means of spores from seed-shaped cases.

Today the Catskills rise abruptly about 3,000 feet from the floor of the Hudson Valley. Their sedimentary strata reveal the constantly shifting patterns of Devonian streams that flowed westward into the shallow but elongated arm of the sea. Accumulating along the western foothills of an ancient mountain range that existed farther to the east, these Devonian sediments appear to have spread westward as broad, coalescing deltas—like several Mississippi deltas that form one much larger delta. It was along these shores that the lush forest of tree ferns flourished. Many of the fossil trees were found in an upright position, buried by sand and mud that the ever spreading deltas brought down from the adjacent highlands farther east.

South of Kingston, the Hudson (only an estuary here, but still popularly called a river) continues dominating the Great Valley of the Folded Appalachian Mountains. But now it strikes obliquely across this broad and fairly level expanse of tilted limestone and shale that dates back

Nearing its terminus, the Hudson glid past New Jersey's Palisades, a line almost vertical cliffs revealing stone c umns hundreds of feet high that we formed by fissures. The Indians nam them the "rocks that resemble trees

to the Early Paleozoic, about 450 million years ago. In contrast, between Newburgh and Peekskill, its course winds through an imposing gorge eroded into bedrock. Here are the Hudson Highlands—the fourth geologic region associated with the river's flow to the sea. The Highlands, a chain of low but rugged mountain ranges, extend about 140 miles from Reading, Pennsylvania, northeastward through New Jersey and southeastern New York into western Connecticut. For the most part the Precambrian rocks underlying this region represent an ancient belt of once much higher mountains whose original sedimentary strata were folded and faulted, then metamorphosed and intruded by magmas of granitic composition during several cycles in the mountain-building phases of the Precambrian.

Gneiss, schist, and some marble are the Highlands' major metamorphic rock types. However, an igneous intrusion, known as Storm King Granite and noticeably more resistant to erosion, forms the crests of most of the highest ridges. Recent radioisotope dating (by the potassium-argon method) of feldspars and micas from the different rocks of the Highlands indicates that the metamorphic sequence of gneiss, schist, and related rock is about a billion years old; Storm King Granite is about 400 million years younger.

To cross this belt of ancient crystalline rocks, the Hudson enters the Highlands through the Storm King-Breakneck Ridge gateway near Newburgh at the northwestern margin and emerges through the Dunderberg-Anthony's Nose gap near Peekskill at the southeastern border. Many of these highland summits, rising boldly from the river to well over 1,400 feet, are familiar to the region's many visitors.

One of the largest of New York's state parks is at Bear Mountain, opposite the sheer bluff known as Anthony's Nose. According to Washington Irving, sturdy Peter Stuyvesant named this stout promontory in honor of Anthony Van Corlear, nicknamed "Anthony the Trumpeter" because his nose was of a "very lusty size, strutting boldly from his countenance like a mountain of Golconda" and because he slew a mighty sturgeon by means of a beam of sunlight refracted fron this "refulgent nose." Far above th river level, Storm King Highwa skirts the flank of Storm King Mountain—the proposed site for the controversial hydroelectric plant—an farther south in the Highlands th military academy at West Poin stands on a small extension of lan jutting into the river.

The southeastern gateway of th Highlands is left behind near Peeks kill. Now the waterway follows course that separates the last two o the geologic regions associated wit the Hudson: on the east the Ne England Upland; on the west th New Jersey Lowland.

Bedrock of the New England Up land, which includes New York Cit is almost entirely a durable meta morphic rock, with some later ig neous intrusions, mostly granite an granite pegmatite. The bedrock rep resents remnants of a long-vanishe mountain range created about 40 million years ago. Most important of the bedrock components is a mica schist; it is the firm foundation for Manhattan's skyscrapers.

Because of its kind of rock foundation, New York City—and particularly Manhattan Island—has attracted active mineral collectors for over a century. More than 170 mineral varieties have been reported from Manhattan alone. Also, it is probable that no other area on the face of the earth has been subjected to such extensive artificial removal of rock through engineering enterprises. Because of this, and because metamorphic and associated igneous rocks can offer a wide variety of mineralogical associations, the mineral record of metropolitan New York exceeds that of any other known area of similar dimension. For example, one of the finest collections of garnet crystals was obtained at Broadway and 65th Street—now the site of Lincoln Center's Philharmonic Hall. Farther down Broadway, at 35th Street, one of the largest, most complete crystals ever found on Manhattan measured six inches in diameter and weighed just under ten pounds. On upper Broadway, at 168th Street, a fragment of garnet crystal twice as large was recovered from still another granite pegmatite vein in the mica schist where the Columbia Presbyterian Medical Center is now located. A thirty-pound specimen of black tourmaline crystal, one foot long and a half foot in diameter, was found in granite pegmatite dike at Fort Washington Avenue and 171st Street.

Now inspect the opposite shore. The New Jersey Lowland is mostly gently inclined sedimentary strata of sandstone and shale formed during the Late Triassic Epoch, about 195 million years ago. They provide massive beds of a fairly hard sandstone known commercially as "brownstone," which is essentially quartz and unweathered feldspar, together with occasional fragments of mica. This is the brownstone, once a popular and fashionable building material, that can be seen in some of the brownstone houses still standing along Manhattan's West Side and in some of Brooklyn's residential areas. Because of its feldspar content it is called arkose sandstone. Also, it often contains hematite, which gives the rock a strikingly blood-red color.

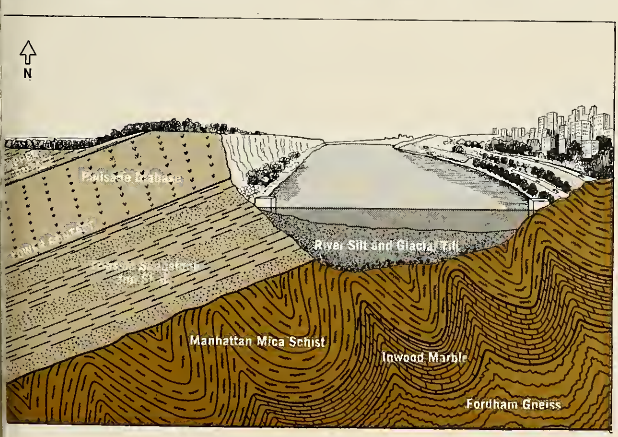
Fossils recovered from these sedimentary strata include part of a reptile skeleton, *Clepsysaurus manhattanensis.* The specimen was collected along the shore at Fort Lee, New Jersey, in 1910, one-half mile south of what is now the west pier of the George Washington Bridge. *Clepsysaurus* belongs to the reptile group called phytosaurs, which vanished at the end of Triassic time. Similar to the crocodilians of Jurassic and later ages, they probably lived in sluggish streams and swamps of the Late Triassic landscape.

Numerous fossil fishes have been discovered in black shales of an abandoned quarry at North Bergen, New Jersey. Exceedingly common is the fresh-water *Diplurus newarki,* member of a unique suborder of fishes called coelacanths. Today they are represented by only one living form, recently discovered in deep waters off the east coast of Africa. During Late Triassic time, the coelacanths were abundant in ponds, lakes, and swamps; then came the black mud that buried them.

It was in the same quarry that three New Jersey high school boys uncovered, in the fall of 1960, the almost complete remains of a unique reptile. Particularly distinctive were the exceptionally elongated ribs apparently attached to a membrane used by the animal for gliding. Since the fossil represented an organism hitherto unknown to science, paleontologists were quite excited by this discovery. Dr. Edwin H. Colbert, Curator of the Department of Vertebrate Paleontology, The American Museum of Natural History, has described the fossil as a completely new genus and species of the suborder Lacertilia (lizards) and gone on to name it *Icarosaurus siefkeri* (Icarus, from the Greek myth about the youth who tried to fly and fell into the sea; saurus, meaning lizard; and the species name in honor of Alfred Siefker, one of the fossil's three discoverers).

In addition, an almost complete skull and other fragmentary remains of a phytosaur were uncovered in the fall of 1963 from this site. Today the fruitful quarry has been all but destroyed by encroaching civilization. It now serves as the foundation for several stores and industrial sites.

The Late Triassic happened also to be a time of considerable igneous activity in the New Jersey Lowland. From deep reservoirs, magma moved up along deep-reaching faults into the sandstones and fossil-bearing shales on the surface. The most striking product of this activity is seen today as a line of almost vertical cliffs, the Palisades. Only comparatively recently, perhaps by the Cretaceous Period, about 80 or 90 million years ago, has it been exposed to view by forces of erosion. As an extensive igneous body, approximately 1,000 feet thick where it underlies Upper Triassic sedimentary rock in the easternmost part of the Hackensack Meadows, it is one of the finest examples of how gravity



sorts out minerals because of differences in their densities. Thus, a concentration of olivine, one of the first minerals to crystallize from a solidifying magma, segregated and accumulated in the lower portion of the intrusion. The remaining igneous rock of the Palisades is composed largely of pyroxene minerals such as augite and plagioclase feldspar. They are arranged in a characteristic pattern. The plagioclase occurs as lath-shaped crystals, oriented at random to yield an interrupted three-dimensional meshwork. Pyroxenes occupy the space between the feldspars. Rocks that show this mineral pattern are described as having an ophitic texture; when the minerals present are small but visible without magnification, such rocks are specifically called diabases.

Another distinctive feature of the Palisades is its line of giant diabase columns that are especially visible from the east shore of the Hudson and have long reminded observers of the palisaded villages and log forts built by the Indians. In fact, the Indian name for the Palisades seems to have been Weh-awk-en; awk, the middle syllable, means "rocks that resemble trees." Close up, one sees that what appear to be roughly polygonal, often hexagonal, columns several feet in diameter and hundreds of feet high are formed by vertical fissures that run up through the entire thickness of diabase rock. They were produced by the cooling and subsequent contraction of the solidifying magma. Exceptionally geometric hexagonal columns can be seen at Devils Tower or the Devils Postpile in Wyoming and California; elsewhere, the Giant's Causeway, near Portrush, County Antrim, Northern Ireland, is an example of this phenomenon. Of course, the perfection of the columns varies greatly, depending on many factors.

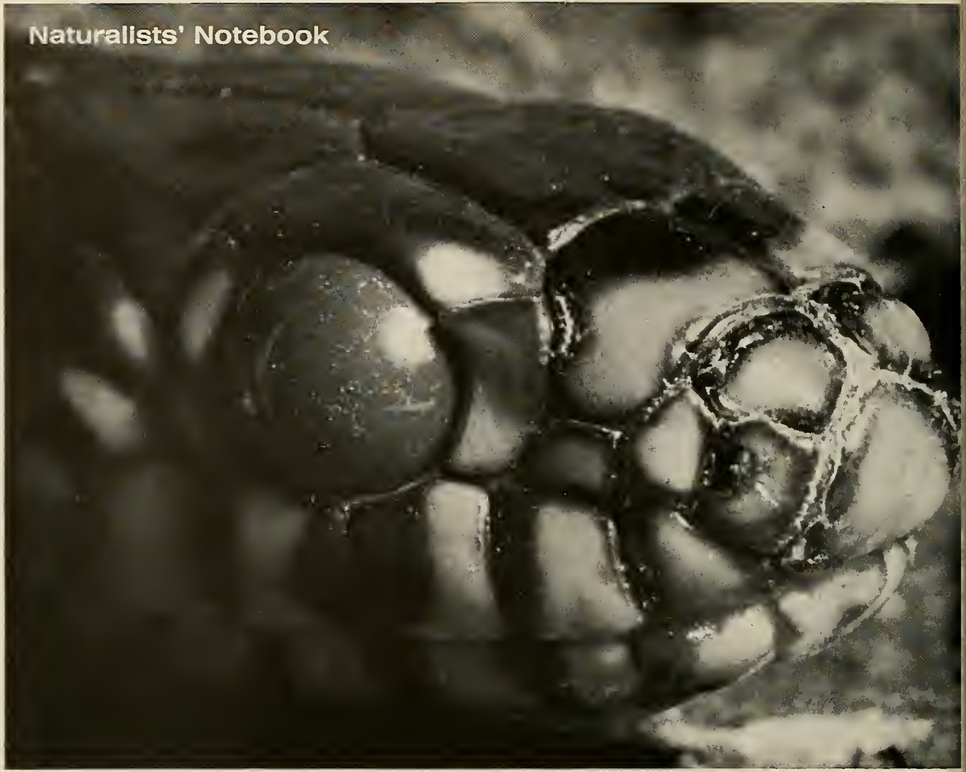
Horizontal joints usually intersect the vertical contraction joints that form the columnar pattern, and with subsequent weathering and erosion, the Palisades ridge tends to break down into masses that look like giant stairways. Trap rock is the standard term for rock masses that show this steplike pattern (trap is the Swedish word meaning "step").

The geologic journey here approaches its end. Soon, three hundred miles from its source, the waters of the Hudson join with those of the East River (also an estuary) to form Upper New York Bay and flow with the rising and ebbing tides under the longest suspension bridge in the world, the Verrazano-Narrows Bridge. The Narrows itself illustrates one other geologic event that occurred in this region, the incursion of a huge and extremely thick lobe of glacial ice—a continental glacier of such proportions that it covered Canada and the northern United States. Metropolitan New York was covered, until 11,000 years ago, by this continental glacier. The ice front advanced as far south as the center of Long Island and Staten Island and probably attained a maximum thickness in the metropolitan New York region of at least 3,000 feet. The tremendous mass of moving ice carried within it large quantities of rock material in the form of clay, sand, pebbles, cobbles, and boulders of all types.

When the ice sheet finally melted northward, the enclosed rock material was left strewn in the form of glacial till. At the point of the glacier's farthest advance this till piled up to form a distinct line of low hills that constitute the terminal moraine. This terminal line crosses the mouth of Upper New York Bay, and the Narrows is where the encircling belt of hills is breached by the combined flow of the Hudson and East rivers.

This breach is vital to the Port of New York. Beyond, the Lower Bay feels the full effects of swells sweeping in from the open Atlantic. In contrast, the Upper Bay is protected. Here, ships of all sizes and types ride at anchor while awaiting their turn to load or unload cargoes alongside the array of docks extending from the shores of Manhattan and Brooklyn. Here, where water from Lake Tear of the Clouds has grown from brook to river to estuary, is one of the world's remarkable harbors.

Passing George Washington Bridge (in foreground) the Hudson's waters sweep on beyond Manhattan, left, and vanish far off at Verrazano-Narrows Bridge.



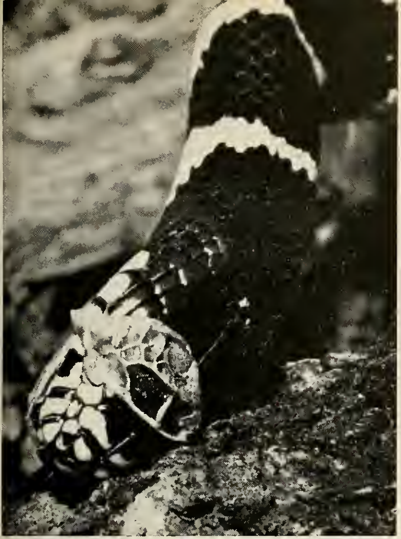
Shedding King Snake

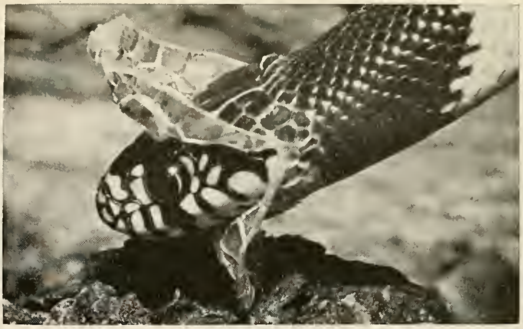
When a snake's body takes on a slightly bluish hue and its eyes opalesce, as they have in the above photograph of a king snake, it is a sign that the snake will soon cast its skin. The opacity, or "blueness," in the eyes, which partially impairs vision, reaches a peak intensity and then gradually fades. A few days after the eyes have again become clear, the skin is cast.

Lizards and snakes, which together comprise the reptilian order Squamata, periodically slough off the outer layer of the epidermis as growth and repair take place in the continuous process of cell replacement. Most lizards cast their skins in patches. But snakes, as the photographs to the right show, normally shed the outer epidermis—the *stratum corneum*—in a single, intact piece. In addition to the *stratum corneum*, snake epidermis has an inner layer, the *stratum germinativum*. Some investigators think that the opacity, or blueness, that precedes exuviation is the result of a substance, perhaps a hormonal discharge, that is secreted between the two epidermal layers to loosen the *stratum corneum*.

Many factors determine the frequency of shedding. A primary one is growth and maturation: young snakes shed more often than old. Other factors include the amount and nutritive value of food; temperature an humidity; and the presence of wounds or abrasions o the skin, which in some instances have been reported t accelerate the onset of exuviation. Snakes do, of cours shed more often than the once a year claimed by trad tional rattlesnake folklore. Indeed, shedding may occu as frequently as every three or four weeks, although th time will vary even with a given individual living und stable conditions.

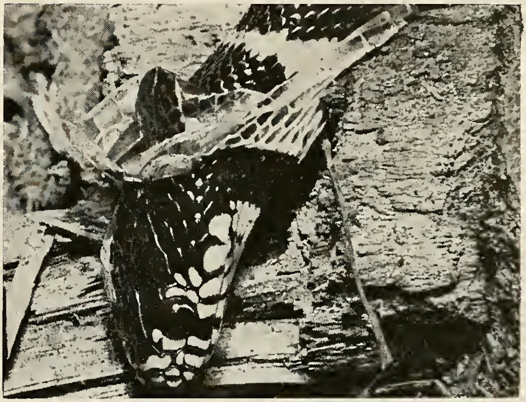
The external anatomy of snakes is, obviously, ideal suited to a one-piece exuviation, since obstructive a pendages are lacking. At the time that actual sheddin is to take place, a snake perhaps will yawn a time or tw (while this often occurs upon waking, it is thought tha just prior to shedding, yawning helps stretch and loose the skin), and may begin nosing or burrowing in san or dirt. A hard or rough surface is frequently used t abrade and break loose the extreme anterior part of th snout so that peeling can begin. Once the head is fre and the skin is folded back, shedding proceeds with eas the snake simply creeping out of the skin. Often at th stage, however, the skin is rubbed and hooked on roug surfaces as it is peeled back inside out.

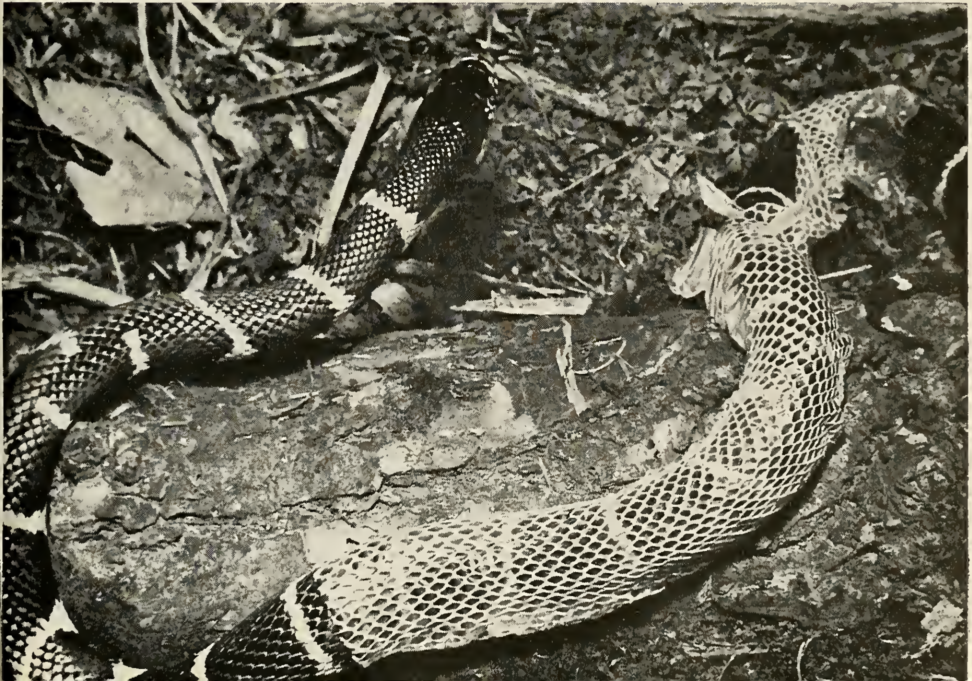




Photographs by Robert H. Wright

This king snake began the skin-loosening process by pressing its snout firmly against a rock and rubbing and pushing for ten minutes. The skin about the nose broke loose first, then that around the lower jaw. The photograph immediately to the right shows the skin snagged, which aids shedding. As the skin turns inside out, the concave "pits" of the inner side of skin are exposed. These readily snag on rough surfaces, giving additional friction for exuviation. The entire shedding process took thirty minutes.





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Setting up a telescope

by James S. Pickering

An essential auxiliary for every telescope is a finder, generally mounted on two rings fastened to the tube of the telescope. Each ring usually has three machine screws that permit accurate alignment and adjustment. Most finders are equipped with fine cross hairs. When finder and telescope are properly collimated, the center of the field of view of the finder is marked by the juncture of these cross hairs and is also the center of the field of view of the telescope.

The faint object you are seeking will invariably be in or near a recognizable group of visible stars. You will be able to pick up all or much of this key group in your finder. Place the meeting of the cross hairs so that your object, usually not visible in the finder, is at the location estimated from the star chart. Then, when you transfer your eye from the finder to the eyepiece of the telescope, the chances are that your quarry will be somewhere in the field of your telescope. A slight adjustment will bring it to the center of this field for the best viewing. Here, as in all details of using a telescope, practice and experience will soon make the transfer from finder to telescope a matter of easy routine.

Eyepieces

There are a wide variety of eyepieces for every type of telescope. The basic principles of eyepieces—the ratio of their focal lengths to the focal length of the telescope objective lens or mirror, their magnifying powers, the fields of view they produce, and so on—have been discussed in an earlier article (November, 1966). It might be well, however, to review these principles.

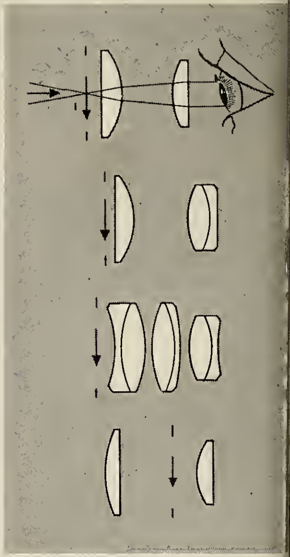
The magnifying power of the telescope is the ratio between the focal length of the eyepiece and the focal length of the objective of the telescope. Most backyard refractors have a focal length that is about 15 times the diameter of their objectives. A 2-inch lens will have a focal length of about 30 inches. An eyepiece with a focal length of 1 inch will then magnify 30 times; a ½-inch eyepiece, 60 times.

The usual focal length of the backyard reflector is about 8 times the diameter of the objective mirror. A 6-inch reflector will have a focal length of about 48 inches. The 1-inch eyepiece will provide a magnifying power of 48, while an eyepiece that has a focal length of ½ inch will magnify 96 tim

There are several varieties of e pieces, known usually by the names the men who devised their optical s tems. Eyepieces are manufactured many different firms, but each firm u the standard identifying name for t eyepiece. Each type has advantages a disadvantages and is best-suited to particular type of telescope and a p ticular observing purpose.

The *Huygens* eyepiece, invented Christian Huygens in the seventeen century, has two lenses separated an air space. It is a negative eyepie that is, the image seen by the obser is formed between the two compon lenses. The Huygens eyepiece is b for telescopes with longer focal leng —with refractors.

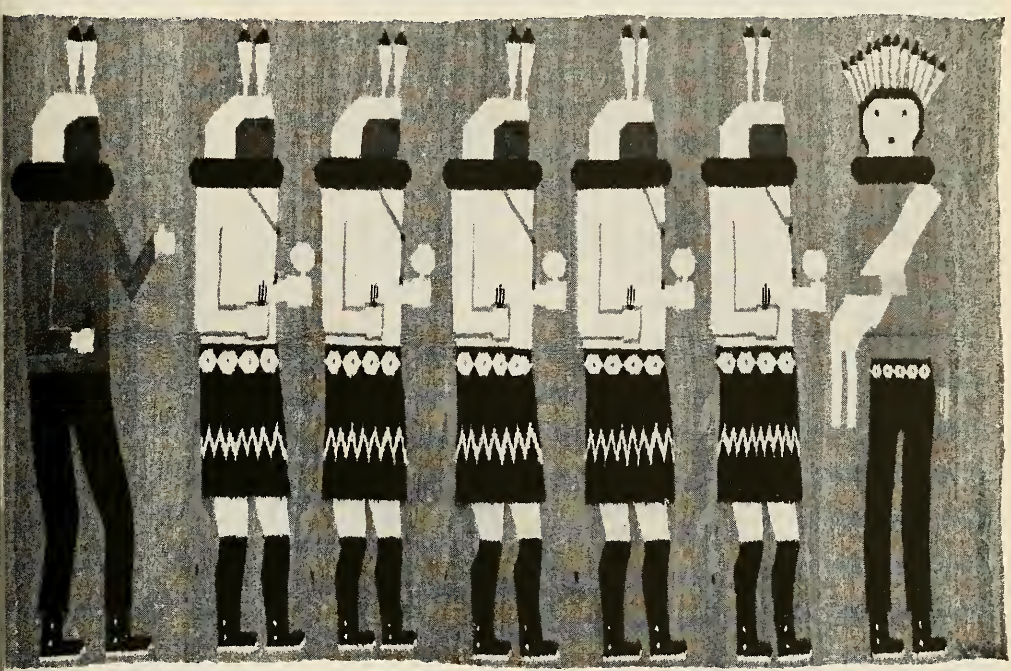
The *Ramsden* eyepiece, devised Jesse Ramsden in the eighteenth c tury, also has two lenses, but the f image that the observer sees is for on the eye side of the eye lens, mak the Ramsden a positive eyepiece. ' Ramsden is best-suited for reflect and shorter-focus telescopes.



Four different eyepieces are, from t Ramsden, Kellner, Erfle, and Huyg

The *Achromatic Ramsden*, or *K ner*, eyepiece is a modification of

NAVAHO



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Ramsden. It contains a third lens that is intended to eliminate the last traces of color aberration caused by the failure of the telescope objective to bring light waves of various lengths to a focus at one point. The achromatic is best for shorter-focus objectives such as reflectors, but it has a tendency to produce ghosts—faint duplicate images

The *Euryscopic*, *Ploessel*, and *Ortho scopic* eyepieces may be used with tele scopes of any focal length. These eye pieces have three elements and are de signed to give a wider field of view than others. The *Erfle* and *Koenig* eyepiece also have this third element and shoul give a wider field.

The *Barlow* lens is a relatively simpl negative lens that is inserted betwee the telescope and the eyepiece. Th single lens of a Barlow is in a tub about 4 inches long and may be move up or down in this tube to its most e fective position. With medium-powe eyepieces, the Barlow will double th power of the eyepiece. It also permit those of us who wear spectacles to kee them on while observing, which is no always possible when the eyepiece used alone.

Remember that the general limita tion of the magnifying power that telescope will accept in an eyepiece about 50 times the diameter of the ob jective lens or mirror in inches. A inch objective will yield about 15 power with the proper eyepiece. Wit a 6-inch reflector, about 300 power possible. The general rule, howeve is to use the *lowest* power, not the hig est. Remember that higher power r duces the field of view and the amou of light that reaches the eye. A sma field of view also shortens the time which the object will be carried acro that field by the motion of the eart

In the conventional backyard tel scope, the medium eyepiece produci about 40 to 60 power should give a fie of view about 30 minutes of arc, abo half a degree. This is nearly the a parent diameter of the full moon.

Resolving Power and Focusin

Another factor that should be und stood by the backyard observer is t resolving power of his telescope. Th is the ability of the telescope to se rate closely associated objects, such the components of double star syster which produce one point of light to eye alone. There is a formula for resolving power of a telescope, kno as *Dawes's Limit*. To find Dawe Limit, divide 4.56 by the diameter inches of the telescope's objective. 6-inch reflector, for example, should able to separate two stars whose an lar distance from each other is ab 0.76 seconds of arc, and a 3-inch ref tor should resolve two stars wit

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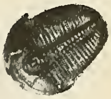
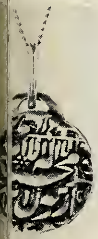

1. Trilobites

2. Roman Empire Perfume Flask

4. Ancient God Coin

5. Holyland Oil Lamp

3. Miniature Opium Weights


C of India

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separation of 1.52 seconds of arc. Dawes's Limit is possible only when the two stars involved are nearly equal in brightness and when observing conditions are ideal. I have never been able to reach Dawes's Limit in the northeastern part of the United States. Don't expect perfection here and you will not be disappointed.

An eyepiece slides snugly into the telescope's drawtube until it is stopped by the wide flange that holds the optical system of the eyepiece. Focusing is usually accomplished by one and sometimes two knurled knobs that move the drawtube, and the eyepiece it contains. in or out until the image is clear and sharp. Stars should show as clean points of light when the focus is correct, with possibly a faint ring of light around the sharp image of the star. This diffraction ring is not always present. but it is normal when seen.

Objects larger in apparent dimension than stars—clusters, nebulae. and the like—should show some detail. The moon is probably the best object on which to start observing and to practice the technique of pointing. following, and focusing. The moon is easy to find and easy to follow as it moves across the field, and it is easy to determine when the various features—craters. mountains. dark maria, and so on—are clear and distinct. Incidentally, the worst time to observe the moon is when it is at full phase. Then the sun is directly above the surface of the moon that is presented to the earth, and there are no shadows. The surface appears flat: about the only lunar features that show best when the moon is full are the rays that extend outward in all directions from some of the larger craters. The full moon also feeds an abundance of light into the telescope, and this may ruin your eye adaptation to the dark. If you wish to observe the full moon, it is well to reduce the size of the telescope's aperture to admit less light. Make a cardboard cap that will fit over the outer end of the telescope tube. In the center of this cap. cut a circular hole about half the diameter of the objective. Another disadvantage of the full moon is that its light drowns out all but the brightest stars. When the moon is full, my advice is to get a good night's sleep.

When you shift from observing the moon or the planets and pick up stars, you may have to change the focus slightly. Here, as with all the mechanical factors of the telescope. practice makes perfect. Don't be disappointed or frustrated if you have minor difficulties at first. Practice focusing until you can almost automatically find the position that will give you the sharpest image with each of your eyepieces, and remember that the lower the power of your eyepiece, the longer the focus will be—you'll have to rack out for low and rack in for high.

James S. Pickering, Astronomer Emeritus and a lecturer at the American Museum-Hayden Planetarium, is the author of "1001 Questions Answered About Astronomy" and "Asterisks."

Location of the Telescope

The whole purpose of our project is to see the sky, so it is logical to select a location for the telescope from which as much of the sky is visible as possible. Your backyard may be ringed with trees, and the houses of your neighbors may loom on all sides, but do the best you can. If possible, put your telescope on any naturally elevated location, with as little obstruction in the form of trees, buildings. and so on as you can find. At some time during the year. the full round of the sky will be visible overhead from your latitude, and the nearer an object is to the zenith—the point directly overhead—the brighter it will appear. Remember. when you are looking at a star near your horizon, you are looking horizontally through many miles of the densest layer of the earth's atmosphere, loaded with water vapor and dust particles. When you look straight up, you are looking through the atmosphere in the most direct manner and there is less interference with the brightness of objects.

Choose as dark a place for your telescope as possible. Ideally, you should be at least 50 miles from any considerable city or town. Industrial haze and the glow that city lights cast into the sky make observing near large centers of population frustrating, if not futile. If you live in the suburbs. make the best of it, and unless you are so unfortunate as to have a city both east and west of you, you will have one dark and one bright side to your sky. Time, again, will move the stars into the best possible position.

Avoid as much extraneous light—from house windows, street lamps, and the like—as you can. Try to find shelter from a street or highway. for the headlights of passing automobiles can cause annoying distractions.

You will need some sort of table on which to put your eyepieces, star charts, notebooks, and other auxiliary equipment. Provide yourself with a flashlight that has a red filter. Red light interferes less with eye accommodation than does white light. It takes from 15 to 20 minutes for your eyes to adapt to the darkness after you have been in a normally lighted room.

In the winter, if you keep your telescope in a heated room, it will take
about half an hour for the lens
mirror to settle down after be
brought into the cold of out-of-do
Set up your telescope before sup
and leave it out with, of course, the
jective protected. Then. when you
ready to observe, the lens or mi
will have gone though its contract
and all will be well. If you try to
your telescope during its metan
phosis. the star images will look
excited spiders.

You will occasionally have fine, c
nights with a spanking breeze blow
Wind will cause vibration that is
the least, annoying. and some sor
windbreak will offer shelter from
breezes and from this vibration. T
is an axiom that the best telesc
mounting is a battleship gun tu
Actually. all the great telescopes
housed inside domes that are cl
except for the slit at the top thro
which the sky may be seen. T
domes are not heated; a telescope m
always be at the same temperatur
the outside air. It is not possibl
use a telescope from inside a he
house with the telescope tube stick
out of a window. In this case. the w
air of the house passing up the t
of a refractor or through the tub
a reflector will create air currents
produce the same effect you might
if you sighted across the top of a c
ney. The images of the stars will
shattered beyond recognition.

Star Charts

The best way to learn the star
to go out some night with some
who has been through the mill,
let him take you. literally, by
back of the neck and point you at
constellations. Failing that, I sug
the simple planisphere, which ca
bought for about a dollar. This
circular map of the sky that s
only the more prominent stars bec
of its small size. The edge of this c
lar section is marked with the day
the year. Fastened at its center
frame, this piece can be rotated.
frame, usually square, covers all
an elliptical section of the circ
piece, revealing the stars for a spe
date. The square is marked with h
so that when the circular sectio
turned to the date and time des
the stars seen at that time are reve
through the opening.

Here, we depart radically from
convention of terrestrial maps, w
are drawn with the north at the
south at the bottom, east to the r
and west to the left. Such maps a
oriented because we are looking
at the earth—we are on the out
looking in. With star charts, we
looking up. We are inside an ima
ary sphere, looking out at its i

ancy and John Seletti aren't trying to save the worl
st a little piece of it.

About a mile outside the Ko-
n village of Ku Am there are a
dozen young, still-tender mul-
y trees growing on a small hill.
neday these trees and their suc-
nt leaves will be the heart of a
village industry—a silk raising
n. That day is still many months
but it doesn't stop the village
from making daily inspection
s up the steep hill, just in case.
in case something miraculous
happened since yesterday. After
t wouldn't be the first miracle
appen in Ku Am. Everyone in
village knows the story of Chang
t, the daughter of the widow.
Ten years ago Chang Sook's
ces of survival were as slim as
was. Her father had disappeared
ng the family's flight from
h Korea. Her mother, a seam-
s, worked a backbreaking day
most of the evening to earn
a month. Barely enough to keep
from starving.
But today that's all changed be-
e an American couple named
ti are sharing a little of their
fortune with a girl to whom a
means everything. Nancy,
and five-year-old Alexandra
ti are New Yorkers. They're not
ously wealthy as the villagers
u Am believe. But, they're not
either. *Comfortable* probably
ribes them best. They have
thing they really need, but
them ten minutes and they'll
up with ten things they want
15 a month would buy. Luck-
cy thought of Chang Sook first.
hrough Save the Children
ration, the Seletti's $15 a
h is doing a remarkable num-
f things. First, Chang Sook's
diate needs and future school-
e being taken care of. The fam-
getting help, too: Enough to
e Chang Sook's mother to start
ll knit shop.
nd with all this, there is still
money left over. This money,
her with money from other
ors, was borrowed by the vil-
o start its precious mulberry
Someday silk raising will
a permanent increase in the
e's income—and permanently

end the need for charity. That's what Save the Children Federation is all about. Although contributions are tax-deductible, it is not a charity. The aim is not merely to buy one child a warm coat, a new pair of shoes and a six month supply of vitamin pills. Instead, your contribution is used to give the child, the family and the village a little boost that may be all they need to start helping themselves.

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$________

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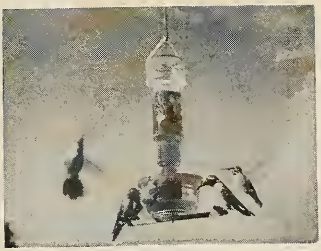

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surface. North is still at the top and south at the bottom of star charts, but east is to the left and west to the right and *you must stand facing south* to use most charts. Those in "Sky Reporter" are to be "rolled around" the horizon. As the stars are moved from rising to setting by the rotation of the earth, they come in from your left and move across the sky to set on your right when you are facing south. The planisphere is built to show this motion. Hold the planisphere up before you as you face south, and if it is properly set as to date and time, you should be able to recognize the constellations and the arrangement of the brighter stars.

There are many excellent star charts for more detailed work. Our criterion will be that of ease in handling them. It is hardly possible, for example, to take into the backyard large, table-sized charts such as Antonin Becvar's *Skalnate Pleso Atlas of the Heavens*. This magnificent set of 16 charts, 21½ by 15½ inches, is, however, invaluable for reference and shows objects as faint as magnitude 7.5.

Less-detailed but more manageable is Norton's *Star Atlas and Telescopic Handbook*. This book is 8½ by 11 inches and has good charts of the entire sky. Stars to the 6th magnitude are shown, together with even fainter clusters, nebulae, and galaxies that may be picked up by your backyard telescope. Norton's is also a good, working handbook of astronomy, with lists of double stars, clusters, nebulae, and galaxies, as well as essential tables and suggestions for observing.

Terrestrial maps are marked w lines of positions, the co-ordinates latitude and longitude, which are us for measuring distances and locati objects on the surface of the ear Latitude is measured north or south the Equator and longitude east or w of the prime meridian, which r through Greenwich, England. S charts are similarly arranged. Declination, which takes care of north a south measurements, is calculated fr the celestial equator, which lies ab the terrestrial Equator. Divided i degrees, minutes, and seconds of which are divisions of the circumference of a circle, declination re from zero, at the celestial equator, 90 degrees at either the north or so celestial poles, which are above terrestrial poles. South declinatior minus and north is plus.

East and west direction is calcula from an arbitrarily selected point the star sphere. This point is the s position about March 21, when it pears to cross the celestial equator its way north for the summer. Thi where the path of the sun around earth through the year—a path ca the ecliptic—crosses the celestial ec tor. East and west distances are ca lated from this point, which is the nal equinox. The east–west dimens is called right ascension. Right as sion is divided into hours, minutes, seconds of time. Right ascension declination, then, are the co-ordin that correspond roughly to terrest latitude and longitude and are the ordinates given in our list of obje

WINTER OBJECTS FOR SMALL TELESCOPES

This is a list of objects that may be found in December and January.

Catalogue Number	Co-ordinates RA	Declin.	Type of Object	Remarks
In the constellation of Auriga				
M-38	5h 25m	+35.8°	Open cluster	Definite cross-shape.
M-37	5h 50m	+32.5°	Open cluster	Loose and widespread.
M-36	5h 32m	+34.0°	Open cluster	Similar to M-27.
Theta	5h 56m	+32.6°	Double star	Mags. 2.7, 7.2. Sep. 3″.
In the constellation of Taurus				
M-45	3h 45m	+24.0°	Open cluster	The Pleiades.
Hyades	4h 18m	+15.5°	Open cluster	Around Aldebaran.
M-1	5h 32m	+22.0°	Planetary neb.	Faint. Debris of supernova.
Aldebaran	4h 33m	+16.4°	Double star	Mags. 1 and 11. Difficult.
In the constellation of Orion				
M-42	5h 33m	− 5.4°	Diffuse nebula	Great Nebula in Orion.
M-43	5h 33m	− 5.0°	Diffuse nebula	Lower part of Great Nebul
Rigel	5h 12m	− 8.2°	Double star	Mags. 1 and 8. Difficult.
Theta	5h 33m	− 5.4°	Quadruple star	Inside Great Nebula.
Sigma	5h 36m	− 2.0°	Quadruple star	Striking group. Mags. 4, 7, 7.5, 10.
Zeta	5h 38m	− 2.0°	Double star	Mags. 2 and 5. Sep. 3″.
Lambda	5h 32m	+ 9.9°	Double star	Mags. 4 and 6. Sep. 4″.
Iota	5h 33m	− 5.4°	Double star	Mags. 3.2 and 7.3. Sep. 1
In the constellation of Gemini				
M-35	6h 07m	+24.4°	Open cluster	Stars in streams.
Castor	7h 15m	+32.0°	Double star	Mags. 2.7 and 3.7. Sep. 5″
Lambda	7h 15m	+16.6°	Double star	Mags. 3.2 and 10.5. Sep. 1
In the constellation of Canis Major				
M-41	6h 45m	−20.7°	Open cluster	Below Sirius.
Nu	6h 34m	−18.6°	Double star	Mags. 6 and 8. Sep. 17″.
Epsilon	6h 56m	−28.9°	Double star	Mags. 1.6 and 8. Sep. 8″.

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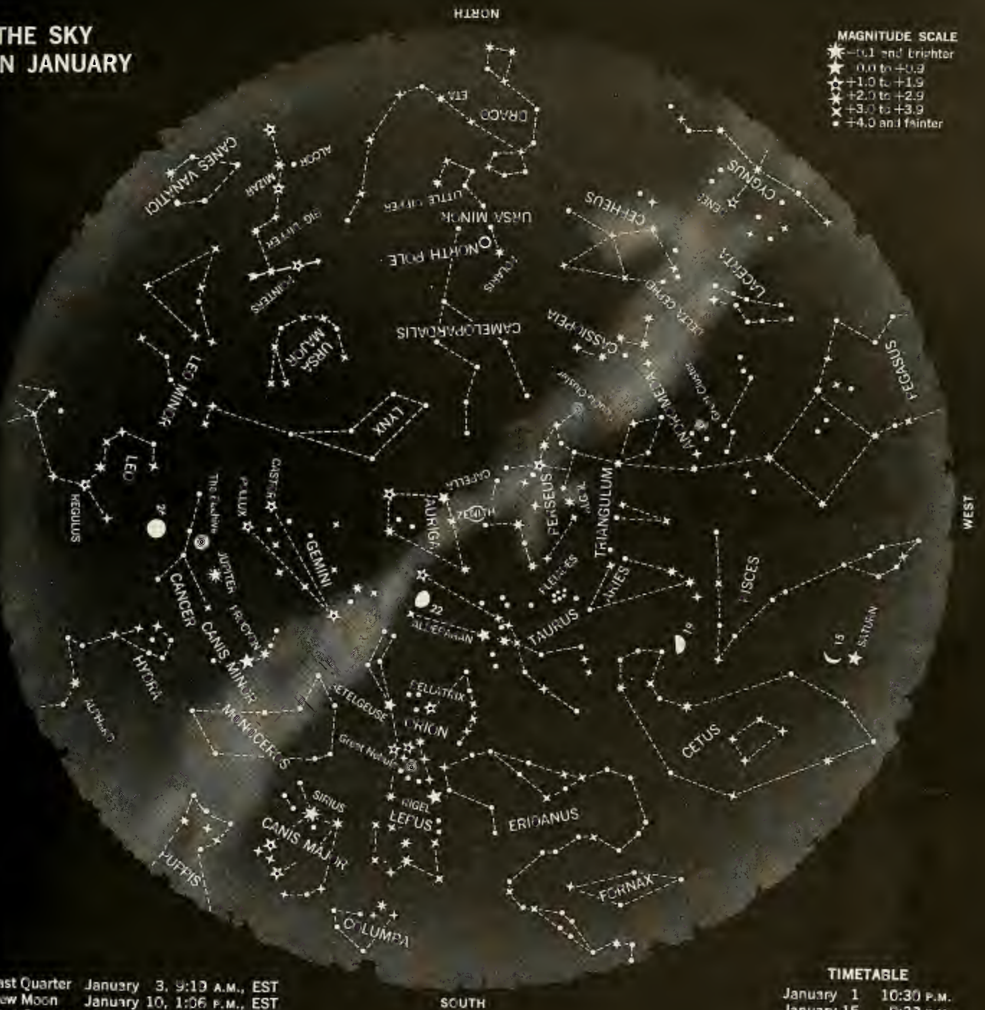
THE SKY IN JANUARY


NORTH
MAGNITUDE SCALE
−0.1 and brighter
0.0 to +0.9
+1.0 to +1.9
+2.0 to +2.9
+3.0 to +3.9
+4.0 and fainter
DRACO
ETA
CYGNUS
CANES VENATICI
ALCOR
MIZAR
LITTLE DIPPER
URSA MINOR
BIG DIPPER
NORTH POLE
CEPHEUS
DENEB
POINTERS
POLARIS
LACERTA
DELTA CEPHEI
CAMELOPARDALIS
CASSIOPEIA
URSA MAJOR
ANDROMEDA
PEGASUS
LEO MINOR
LYNX
Double Cluster
Great Galaxy
LEO
REGULUS
CASTOR
POLLUX
The Beehive
CAPELLA
AURIGA
ZENITH
PERSEUS
ALGOL
TRIANGULUM
GEMINI
JUPITER
CANCER
CANIS MINOR
PROCYON
22
ALDEBARAN
PLEIADES
TAURUS
ARIES
PISCES
19
15
SATURN
HYDRA
ALPHARD
MONOCEROS
BETELGEUSE
BELLATRIX
ORION
Great Nebula
CETUS
SIRIUS
CANIS MAJOR
RIGEL
LEPUS
ERIDANUS
PUPPIS
FORNAX
COLUMBA
WEST
SOUTH

Last Quarter	January 3, 9:19 A.M., EST
New Moon	January 10, 1:06 P.M., EST
First Quarter	January 18, 2:41 P.M., EST
Full Moon	January 26, 1:40 A.M., EST

TIMETABLE

January 1	10:30 P.M.
January 15	9:30 P.M.
January 31	8:30 P.M.

(Local Mean Time)

January 2: The earth is at perihelion, at a distance of 91,396,000 miles from the sun.

January 2-3: Mars is near the last-quarter moon in the morning sky, to the left and below the moon on the 2nd, and to the right and above on the 3rd.

January 3: The Quadrantid meteor shower, a brief one producing 40 meteors per hour, reaches maximum, but the last-quarter moon will brighten the after-midnight sky.

January 11: If the western sky is exceptionally clear tonight, it may be possible to see the 30-hour-old crescent moon, with bright Venus nearby.

January 15: Saturn is the bright planet above the north cusp of the crescent moon. Conjunction of the moon and Saturn is at 6:00 P.M., EST.

January 17: Mercury is at superior conjunction, moving into the evening sky.

January 18: Mars and Spica are close in the sky this morning, both rising in the east as dawn approaches. On subsequent mornings, Mars will move to the left of Spica, until March 8, when the planet becomes stationary. It then begins to retrograde, approach Spica again, and pass to the right of the star on April 23. After moving to the west (right) for a time, Mars will again become stationary on May 27, resume direct motion, and pass Spica for the third time this year on July 3.

January 20: Jupiter is at opposition, exactly opposite the sun in our sky, rising in the east at sunset, highest about midnight, setting in the west at dawn.

January 24-25: The bright object you will see within the glare of the high, brilliant, nearly full moon on these nights is Jupiter.

January 30-31: The moon passes close to Mars in the morning sky for the second time this month. An occultation, visible in the Antarctic, occurs at 4:00 P.M., EST, when the moon and Mars are in conjunction.

All Month: The evening sky includes Saturn—toward the southwest at dusk; Venus—low in the west and seen with difficulty; and Jupiter—rising in the east. Jupiter may also be seen in the west before dawn, together with Mars—higher and toward the south. Mercury is not visible.

The excavation at Nimrud

by Cyrus H. Gordon

Nimrud and Its Remains, by M. E. L. Mallowan. Vol. I and II. *Dodd, Mead and Co., $60.00; 680 pp., illus.*

There are many archeological excavations in progress, and countless archeological reports are being published. However, few excavations have yielded the rich harvest of finds that Professor Mallowan has unearthed at Nimrud, and few reports are as thorough, interesting, and handsome.

As one reads this book he comes across translations of texts discovered at Nimrud in which the Assyrian kings who ruled there call themselves "King of the Universe." This title is fraught with meaning because the monarchs of Assyria not only claimed but implemented to a considerable extent the doctrine that the pantheon headed by Ashur had destined them to rule the world. Shalmaneser III, Tiglath-pileser III, and other kings conquered far and wide into Iran, Anatolia, Syria, and Palestine. Under the Sargonids, Egypt was incorporated into the Assyrian Empire during the reigns of Esar-Haddon and Assur-bani-pal. Accordingly, the capitals of Assyria (Assur, Nineveh, Nimrud, and Dur Sharrukin) were not merely national capitals; they were capitals of a world empire. In all of Europe and America there is only one famous city that can make such a claim: Rome. In Assyria there are four, and Nimrud is one of them. In the finds described in Mallowan's account there are texts that refer to widespread conquests, and some of the handsomest works of art were trophies of war brought to the capital from afar by conquering monarchs.

In the mid-nineteenth century there were pioneers, like Austen Henry Layard, who first excavated quantities of ancient treasure from the capitals of Assyria and inaugurated the age of archeological discovery in Mesopotamia. Layard's *Nineveh and Its Remains* (2 vol., London, 1848-49) is a model of important subject matter fascinatingly described. Excavation has meanwhile become a highly specialized discipline, and archeologists are no longer pioneers like Layard, but instead are meticulous academicians. As a result, the general, discriminating reader is not likely to pick up an archeological report and read it for pleasure (nor even in the hope of much edification). Emulating Layard, Mallowan has consciously sought to recapture the spirit of the local environment as well as describe the materia interestingly. The very title *Nimrud an Its Remains* is patterned after *Nineve and Its Remains.*

One of the most attractive forms o ancient Near East art is the Phoenicia ivory. These carved ivories were highl prized, and they have been found a many sites. They were often used t adorn beds, chairs, tables, boxes, an trays; many were carried off as trophie to Nimrud from western centers suc as Carchemish, Hama, Damascus, Tyr and Samaria. Mallowan's excavatio has yielded by far the greatest know collection of these ivories; among myriads of fragments are hundreds of large pieces. Here we have quality as well a quantity. A head carved out of an el phant tusk has been nicknamed "Mon Lisa"; it is the outstanding masterpie of Phoenician ivories. Just as "Th Lady of Elche" (*see cover,* Natura History, January, 1966) is the superi sculpture of the western Phoenician this "Mona Lisa" is the finest sculptu bequeathed by the eastern Phoenician The color plates and the black-an white photographs of these ivories alo are worth the price of the book.

The first volume deals with the ma mound of Calah (as Nimrud is called Genesis 10:11; the Assyrians called Kalkhu): palaces, temples, ziggura private houses, treasure-laden wells, ar individual finds. The second volume d scribes the construction and contents Fort Shalmaneser, built a short distan from the great mound. An importa collection of ivories was also found the Fort. Fort Shalmaneser was ordinary building. Covering eighte acres it served as a fortress, arsen and palace. To become and remain world empire, Assyria had to conce trate on militarism; this is why t government and the army were ine tricably intertwined at Nimrud.

The author has provided the prof sional archeologist with a precise rep that will stand as a permanent reco and, at the same time, has given t reading public a lively narrative. F example, the hinged and folding ivo boards with waxed, sunken surfaces the inside for writing are interesting themselves. Few people have been awa of cuneiform written on any permanen soft material. (Clay tablets were scribed when wet and soft, but on they dried no more cuneiform could

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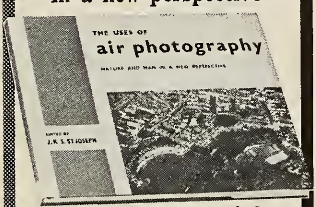
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– EUROPE –

MEDITERRANEAN: Height of spring from Porugal to Turkey, stressing Mediterranean birds and flowers. April 16; 4 weeks. (See next).

IRON CURTAIN: Little-visited areas of Turkey, Bulgaria, Hungary and Poland, plus Russia from Leningrad to the Black Sea. May 13; 4 weeks.

BRITAIN: Nature highlights of England, Wales and Scotland at peak of bird nesting season. May 27; 3 weeks.

SCANDINAVIA: Thrilling circuit of the Far North: Norway's mountains, fjords and islands; North Cape and the midnight sun; Lapland and Sweden. Two departures—June 18 & June 25; 4 weeks.

ICELAND: Arctic wildflowers, nesting birds and seabird cliffs against a weird background of volcanoes, geysers and waterfalls. Two departures—June 4 & June 25; 2 weeks. Optional excursion to Greenland after each tour.

– AFRICA –

SOUTH AFRICA: Southwest Africa, Kalahari Desert, Cape of Good Hope, Kruger Park. July 22; 3 weeks. Connects with next.

EAST AFRICA: Rich bird & mammal regions of Kenya, Tanzania, Uganda. Aug. 12; 3 weeks.

– SOUTH AMERICA –

COLUMBIA: Intensive bird observation in the world's top bird country. July 15; 3 weeks.

PERU-ECUADOR: Birds of the upper Amazon and Andes, incluring Machu Picchu & Bolivia. Aug. 5; 3 weeks, plus optional Galapagos trip.

– AUSTRALASIA –

The following 4 trips connect in sequence, repeating the highly successful South Pacific venture of 1965. Expert local bird leadership.

BIRDS OF MELANESIA: Fiji, New Caledonia, New Hebrides, Solomon Islands and 2 weeks in New Guinea. Sept. 9; 4 weeks.

AUSTRALIA WEST & NORTH: Perth to Darwin and Alice Springs. Oct. 7; 3 weeks.

AUSTRALIA EAST & SOUTH: Barrier Reef, Queensland, southern Australia and Tasmania. Oct. 28; 3 weeks.

NEW ZEALAND: South with the spring from Auckland to Stewart Island, including Mt. Cook and Milford Sound. Nov. 18; 3 weeks, plus optional 2-week botany trip up west coast.

– NORTH AMERICA –

TEXAS-MEXICO: Bird highlights of Texas coast and N.E. Mexico. Mar. 26 (Easter); 2 weeks.

ARIZONA: Richest part of U.S. for rare bird species, desert flora. May 13; 2 weeks.

The following 4 tours constitute a connected series visiting nature highlights of the Pacific Coast from Mexico to Alaska, emphasizing National Parks, Forests & Wildlife Refuges. 2 wks. each.

SIERRAS, San Diego to San Francisco; June 10. **CASCADES & COAST RANGE,** San Francisco to Vancouver; June 24. One-week interval for Inside Passage cruise. **ALASKA,** including Glacier Bay, Katmai and Mt. McKinley; July 15. **ALASKA OUTPOSTS,** the Arctic Coast east of Barrow, the Pribilofs and two spots in the Aleutians; July 29.

– COMING LATER –

ASIA: (1) India & Nepal; (2) Thailand & Malaysia; (3) Philippines; winter 1968-69. Also (4) Japan, May 1968. Three weeks each.

AFRICA: (1) No. Africa, Atlas Mtns.; (2) West Africa, Senegal to Angola; (3) Central Africa & Madagascar; (4) Ethiopia North. In 1968 and 1969; 3 weeks each. Also see above.

SOUTH AMERICA: (1) Chile & Tierra del Fuego; (2) Argentina; (3) Brazil; (4) Venezuela, Trinidad & Guianas. Also repeat 1967 tours.

MIDDLE AMERICA: Six routes in Mexico, including Yucatan, two in Central America, two in West Indies. Two weeks each; details on request.

NORTH AMERICA: (1) Florida; (2) Newfoundland & Labrador; (3) Great Basin; (4) Rocky Mtns.; two weeks each. And in 1969 a retracing of the Peterson-Fisher "Wild America" route from New England to Mexico to Alaska, in 4 3-wk. segments.

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written on them.) The writing boards found at Nimrud were made for an astrological text of omens to be set up in the palace of Sargon at Dur Sharrukin. Mallowan's discussion of the waxed writing boards is not only technically satisfying; it is also an engaging comparative study of wax tablets throughout history and literature. Moreover, the story forms part of an unforgettable account of how treasures are extracted from ancient wells.

There is a lot of cultural and political history in *Nimrud and Its Remains.* A background in that history will certainly make this work more meaningful. However, the book will open so many vistas for the curious, although uninitiated, reader that it is a good place to begin the study of Mesopotamian and Near Eastern archeology. Too many books on this subject are written by popularizers with few, if any, professional qualifications. Here is an authoritative but readable book by a master of the craft.

It was as neighboring archeologists in Assyria that Mallowan and this reviewer became acquainted. Accordingly, it is a pleasure to review the crowning achievement of M. E. L. Mallowan's distinguished career so far: a career that I have followed from its early promise to mature fulfillment.

Cyrus H. Gordon is Chairman of the Department of Mediterranean Studies, Brandeis University, and a specialist on the origins of Western civilization.

Ancient India, by D. D. Kosambi. *Pantheon Books, $6.95; 243 pp., illus.*

No matter what approach an author takes in describing ancient Indian history and culture, whether philosophical, political, culinary, environmental, or archeological, the end result is almost invariably enchanting. The teeming world of India's past has so many facets and is colored with so many prime hues that authors would appear to have their initiative taken away, as the subject itself, motivated by some incredible energizing mystique, takes over and writes its own account. This is almost an axiom of Indian historiography, and the present author is a fine example of its verity.

The book is divided into seven basic parts: a review of the problems of writing Indian history and a definition of India; three sections on the rise to civilization out of a prehistoric background; and three engrossing sections on the medieval India that arose out of the Vedic period and closed with the Islamic conquests. In the latter sections, much is written about the cultural background out of which arose Jainism, Buddhism,
and Hinduism. The section on the natur
of the early Indian states involves
graphic view of the problems of econom
ics, religion, the progress of scienc
land administration, and society.

The author is an Indian, and his pr
mary sources are Sanskritic and othe
literary materials, which he interpre
with considerable skill and a refreshin
manner. He attempts to interrelate th
literary traditions with aspects of rece
archeological findings, and in this he
least successful. However, the book
rich in information, graphic in the wri
ing, and indeed well worth the readin

Walter A. Fairservis, J
Burke Museum, U. of Washingt

Khmer Sculpture and the Angk
Civilization, by Madeleine Gitea
Harry N. Abrams, Inc., $25.00; 301 p
illus.

Since the chance discovery in 1860
the amazing ruins of Angkor, nume
ous publications by French archeol
gists have made increasingly familiar t
monuments of the ancient Khmer civi
zation that flourished in the jungles
Cambodia from about the seventh to t
fourteenth century. The majority of t
publications dealing with Khmer a
have concentrated on the enormous e
fices of the temple complexes, convin
ing symbols of the power of the Khm
empire and its god-kings. The prese
lavishly illustrated volume—24 plates
color and more than 100 in black a
white—attempts a closer view of t
stylistic development of Khmer scul
ture through some sensitive, though
casionally oversimplified, analyses of i
dividual masterpieces. The auth
Madeleine Giteau, has excellent crede
tials for writing a popular survey of t
kind; she has lived in Cambodia f
eighteen years and has served as C
servator of the National Museum
Phnom Penh. Unfortunately, althou
the plates are magnificent, the text fa
short of expectations, providing neith
a connected introduction to the subj
nor an adequate commentary on the
lustrations. Furthermore, many imp
tant sculptures discussed in the text
not illustrated at all, and among th
that are, too frequently only a sm
detail is given.

The organization of the text is logi
enough. The sculptures are arrang
into three sections according to ma
rial: stone, bronze, and wood. Howev
neither bronze nor wood sculptures s
vive in sufficient numbers to warrant
cussion in a separate context and t
seventeenth-century wood pieces that
illustrated are unenthralling as well
late. Mlle. Giteau's poetic attempts
evoking the "subtle, gay and measur
mood of the sculptures occasionally s
fer in translation from the origi

'rench. The text is concerned primarily
ith an appreciation of the style of the
:ulptures, and the few attempts to re-
ıte them to the broader context of
.hmer "civilization" seem an after-
ıought and do not come off. The eight
ıldout tables of "Comparative Chronol-
gy" appear pretentious since the text
so general and largely unhistorical.
hough seemingly intended to illumi-
ate aspects of Khmer civilization, the
ıpplementary Catalogue of 135 illustra-
ons (arranged under such baffling
eadings as "Life in the Palace," "Wom-
ı's Skirts," and "Emotion") is of
ubious value.

When weighed in the balance, the
ıok—despite its substantial appearance
is found wanting; its price is too steep,
en for such beautiful illustrations.

WAYNE E. BEGLEY
University of Iowa

RIMATE BEHAVIOR, edited by Irven
eVore. *Holt, Rinehart and Winston,*
c., $10.00; 654 pp., illus.

RY as hard as we may to view research
on apes and monkeys with objectiv-
, we tend to apply our human behav-
ral criteria to these closest phylogen-
ic relatives of man. That is why the
:aightforward descriptions in *Primate*
havior are particularly welcome. The
ok provides a useful, up-to-date refer-
ce source on a number of species of
n-human primates and gives us the
portunity to examine group behavior
d individual interactions within sev-
ıl societies of apes and monkeys under
tural conditions.

The obvious scientific value of field
ıdies has been apparent for a consider-
le time, but only since the 1950's have
ncerted efforts been made to fill the
ed. Investigators have literally taken to
woods and have set up housekeeping
der frequently arduous conditions in
midst of gorilla, chimpanzee, rhesus
nkey, and baboon societies. They have
ent months observing, measuring, and
ording. Some grew to know their ani-
ls fairly intimately. For example, this
rom Jane Goodall's chapter on chim-
ızees: "Sneezing was heard on four
arate occasions and three individuals
re heard coughing . . . one male suf-
ed for at least two weeks from what
eared to be a cold. His nose was con-
ıally running, he wheezed, coughed
average of twice per day for one
k. . . ."

Primate Behavior is the result of a
thesis that took place at the Center
Advanced Study in the Behavioral
ences, in Stanford, California, where,
nine months, the twenty-two authors
luated, re-evaluated, examined, and
lyzed the data that had resulted from
ir many hours of study and observa-
ı in the field. They agreed on the
nat to be used so that, although many

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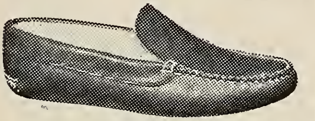

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primates are described in separate chapters, the book has continuity. Each author, wherever possible, covers basic ecology, group organization, interrelationships of the group members, general and specific behavior, normal food preferences, living quarters, locomotion, reproductive cycles, versatility and adaptability in new situations, and infant and juvenile development. Locale maps, photographs of activities, and corroborating technical data are included. Certain statistical inadequacies and inaccuracies appear among the technical details and tables scattered among several chapters, but they do not mar or impair the over-all usefulness of the book, nor do they interfere with its readability.

The book is divided into three sections: one on monkeys, one on apes, and one on the comparative aspects of the various groups discussed. In each case highly qualified men present their findings on baboons, rhesus monkeys, bonnet macaques, langurs, howler monkeys, lemurs, mountain gorillas, chimpanzees of the Budongo forest, and chimpanzees of the Gombe Stream Reserve. Comparative reviews include one on the apes by George Schaller, whose special area of investigation was the mountain gorilla. Dr. Schaller also presents a short chapter on the methodology of field studies, which is somewhat surprising. I should think that, rather than having a set routine to guide one, the emphasis should be on the need for great adaptability and flexibility on the part of the investigator. Each field situation must call for its special methods.

Lancaster and Lee present data on comparisons of annual reproductive cycles that, incidentally, had not been known from laboratory studies of several groups. Social development among monkeys and apes is compared, and various aspects of communication are discussed. Other features include a preface covering classification and phylogenetic relationships of apes and monkeys, and a summary of the adaptiveness of the behavioral repertoire of the non-human primates. This last chapter, unfortunately, is wishy-washy and written without conviction.

There are over four-hundred original research references listed at the end, in addition to the index. This book will be consulted often and may serve as the final arbiter in arguments about what apes and monkeys do and do not do.

EVELYN SHAW
The American Museum

THE ART OF ANCIENT IRAN, by Edith Porada. *Crown Publishers, Inc., $6.95; 279 pp., illus.*

ANIMALS were often the subject of ancient Iranian art, but decoration rather than representation was their purpose. Dr. Porada is doubly qualified to
do this "animal art" justice. Besides e
celling in the analysis of ancient a
styles, she derives an intimate knowledg
of wildlife from her childhood in th
Austrian Alps, where she still maintain
a second home.

In addition, she brings inform
tion from contemporary enthnographi
sources to bear on her topic in an a
tempt to establish the meaning of certai
recurrent themes, such as a tree flanke
by ibexes. In the remotest Indo-Irania
speaking corner of central Kashmir, th
cult of a goddess of childbirth and hun
ing, associated with ibexes and junip
trees, survives to the present day.

The recurrence of such motifs revea
the underlying continuity of much
Iranian art, and the author cleverly us
these as threads to guide the read
through the wealth of material—fro
royal treasures to peasant pottery.

Scorning the conventional treatme
of Iran as a historical and cultural va
uum into which the splendor of the Pe
sian Empire burst forth without prep
ration, Dr. Porada has condensed th
well-known Empire periods (Achaem
nid to Sasanian) in the last four cha
ters of the text, followed by exhausti
notes, bibliography, charts, and inde
In the first eleven chapters she brin
"prehistoric" Iran of the sixth to th
early first millennium B.C. into foc
and we learn to distinguish a group
interrelated cultures, in close conta
with the neighboring centers of Mesop
tamian civilization, but early manife
ing certain native preferences.

Iranian archeology is in a consta
state of flux, as new excavation repo
are published or new objects appear
the market. Presenting many recent fin
in this lavishly illustrated volume of t
"Art of the World" series, Dr. Pora
lets the reader participate in buildi
the latest available clues into a n
picture of early Iranian civilization.

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is not only an essential reference wo
for the scholar but a joy to the eye a
entertaining reading for the layman.

MAURITS VAN LO
The Oriental Institute, U. of Chic

This list details the photographer, arti
or other source of illustrations, by pa

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20—N.Y. Botanical Garden
22-23—Napoleon A. Chagnon
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25—top, N. A. Chagnon; bottom, K. Weidmann
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Liquor, the Servant of Man. M. Chafetz. Little Brown & Co., Boston, 1965.

Drugs and the Mind. R. S. de Ropp. Grove Press, Inc., New York, 1957.

Phantastica: Narcotic and Stimulating Drugs. L. Lewin. E. P. Dutton & Co., New York, 1964.

YANOMAMÖ— THE FIERCE PEOPLE

People of the Rain-Forests. G. Seitz. Heinemann, London, 1963.

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The Upper Devonian Forest of Seed Ferns in Eastern New York. W. Goldring. *New York State Museum Bulletin* 251, pages 50-72, 1924.

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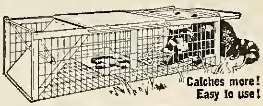

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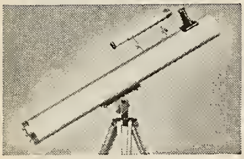

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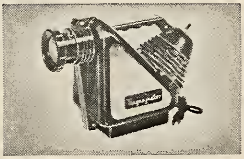

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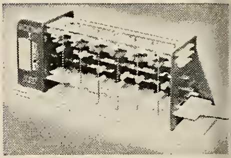

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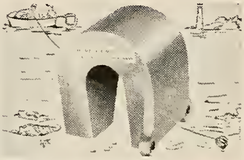

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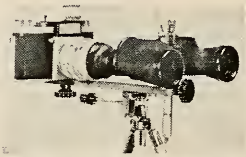

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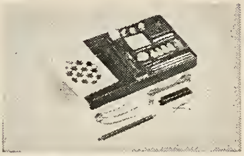

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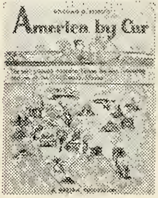

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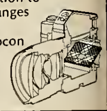

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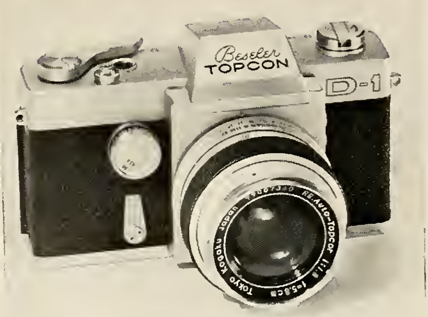

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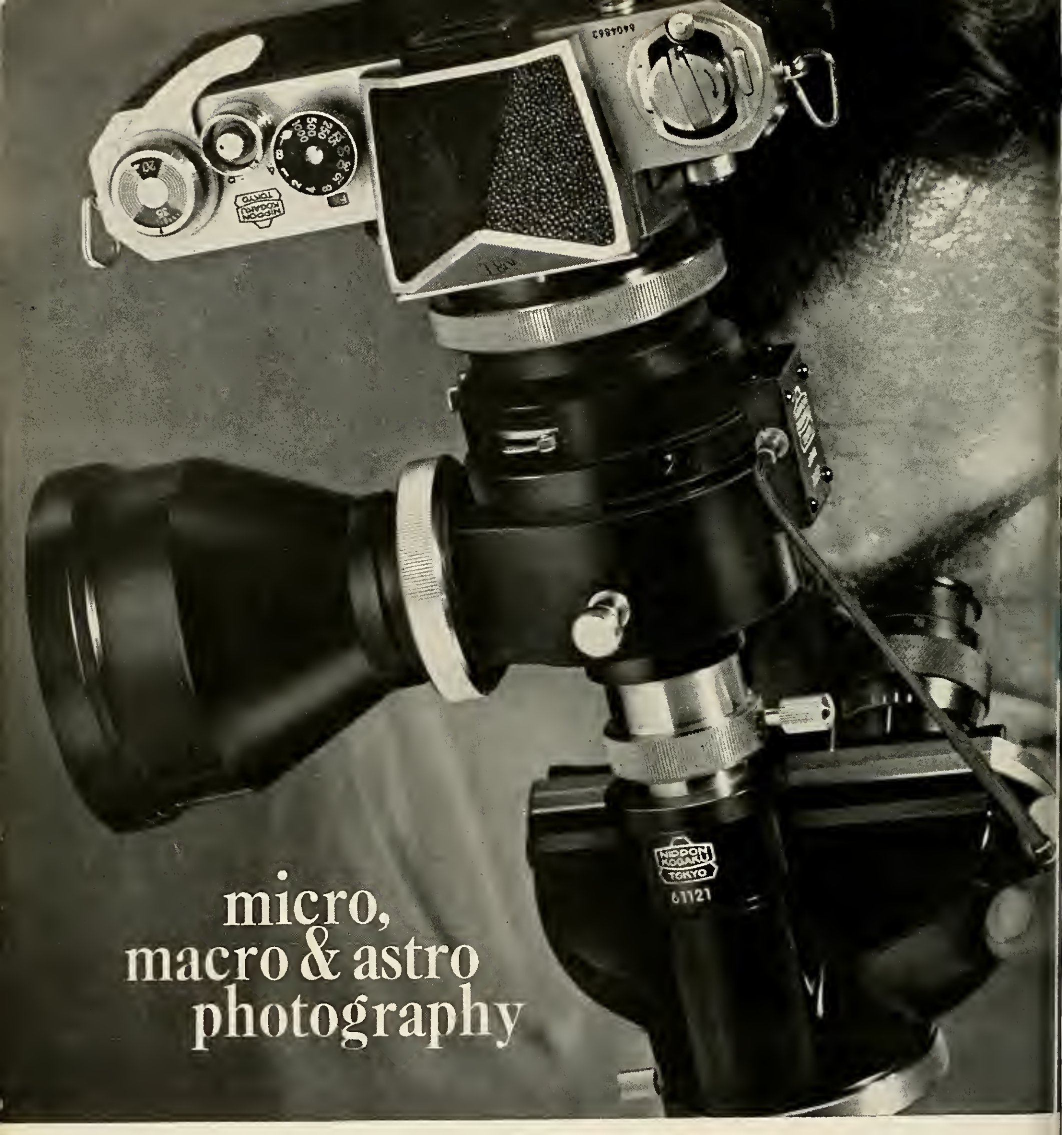
Natural History

African Predators and Scavengers



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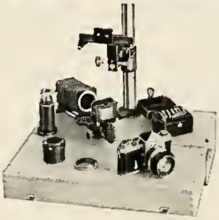

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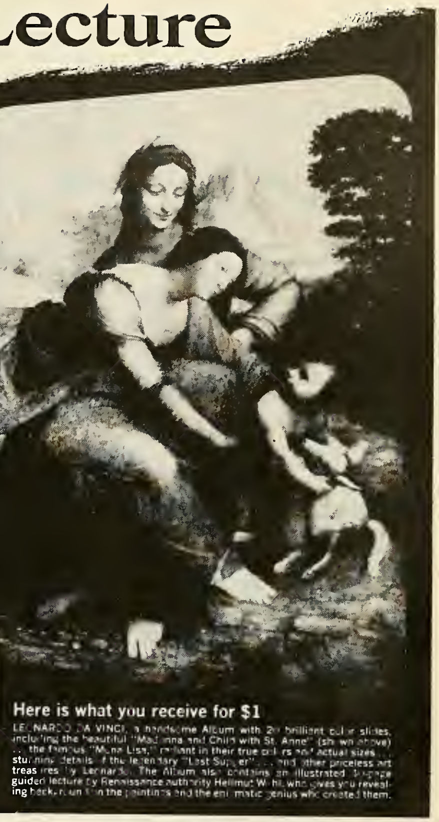

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THE JOURNAL OF THE AMERICAN MUSEUM OF NATURAL HISTOR

Vol. LXXVI FEBRUARY 1967 No.

ARTICLES

PREDATORS AND SCAVENGERS *Richard D. Estes*

THE ANTLERS OF NARA *Photographs by Konosuke Muramatsu*

NEW IDEAS ON THE RED SHIFT *Thomas D. Nicholson*

CAVE LIFE ON THE PALOUSE *Gerald H. Grosso*

MIMICRY *Miriam Rothschild*

UNRAVELING THE AGE OF EARTH AND MAN *E. L. Simons*

EUGLENA AND THE TIDES *John D. Palmer*

DEPARTMENTS

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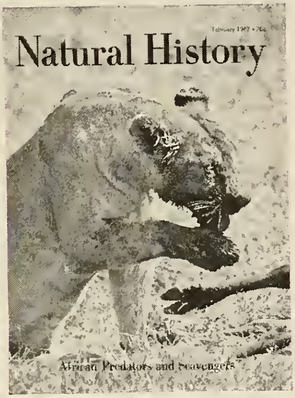
NEW ERA FOR THE AMERICAN INDIAN *Robert L. Bennett*

A NATURALIST AT LARGE *Marston Bates*

BOOKS IN REVIEW *Edwin B. Matzke*

THE SKY IN FEBRUARY

SUGGESTED ADDITIONAL READING



COVER: Having in typically feline fashion successfully stalked and kill healthy adult wildebeest in the Ngorongoro Crater in northern Tanzania lioness whose photograph is reproduced on this month's cover takes an ur ried moment for personal hygiene. As discussed in Richard D. Estes' two article on relations between certain African predators and scavengers, initial installment of which begins on page 20, the lioness may shortly en ter significant competition for the remains of the wildebeest not only roving and often aggressive bands of hyenas but from other lions as

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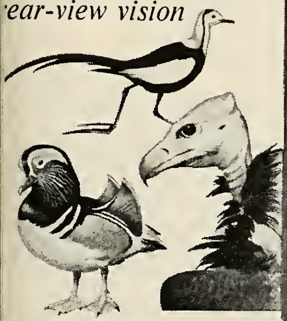

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Richard D. Estes spent two and a half years living in the Ngorongoro Crater in Tanzania, studying the animals about which he writes in his two-part article, "Predators and Scavengers." Presently finishing his Ph.D. thesis for Cornell University, Mr. Estes plans to return to Africa in June for a two-year study of the ecological niches filled by various African animals. He hopes also to compare sable and roan antelopes. His professional goal is a career in international conservation, specializing in rare, endangered, or key African species. His doctoral thesis on the behavior and life history of the wildebeest will be published as a book in 1968.

John D. Palmer was a National Science Foundation Postdoctoral Fellow to the University of Bristol, England, in 1963-1964. While there, he studied the migratory life of the *Euglena*. He is presently Associate Professor of Biology at New York University and is a corporation member of the Marine Biological Laboratory in Woods Hole, Massachusetts, where he has been a summer researcher for the past seven years. Dr. Palmer holds a Ph.D. from Northwestern University. His primary research interests are the biological rhythms in algae, crabs, and birds.

Gerald H. Grosso has been called a "semipro" archeologist. Although his vocation is that of military affairs editor of the *Bremerton* [Washington] *Sun*, his avocation has long been archeology. Mr. Grosso spent several years as an associate member of the Marmes rock shelter archeological dig, about which he wrote "Cave Life on the Palouse." He is currently preparing articles on a new archeological investigation of the Ozette Indians. Mr. Grosso also studies marine biology and geology, collects northwest history, and works on stained-glass windows.

Miriam Rothschild was born in Ashton, England, a member of a famous banking family, many of whom were keen amateur naturalists. As a child, she spent much of her leisure studying in the Tring Museum in England, where her uncle had amassed a worldwide collection of animals and insects, including two and a half million butterflies; thus she became a naturalist at an early age. Miriam Rothschild has written over a hundred papers on varied subjects, from diseases of snails to mimicry in scen and sound. She was also joint author of a popular book, *Fleas Flukes and Cuckoos.*

Elwyn L. Simons, who wrot "Unraveling the Age of Earth an Man," is Associate Professor of Geology and Curator of Vertebrat Paleontology at Yale University. H is also curator of Yale's Peabod Museum of Natural History. D Simons holds a Ph.D. in biolog geology from Princeton and D.Phil. in primate paleontolog from Oxford University. He h written numerous papers and is member of several scientific soci ties. Dr. Simons is also a Researc Associate at The American M seum of Natural History.

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NEW ERA FOR THE AMERICAN INDIAN

The plight of "The Enduring Indian" was eloquently described in our November issue. Here, a Washington administrator—himself of Indian descent—explains the reform program now under way.

By Robert L. Bennett
Commissioner of Indian Affairs

Relationships between the fed-
eral government and the
American Indian tribes of this coun-
try have fluctuated drastically ove
the past century or more. Most o
the policies over the years have ha
the best interests of the Indian peo
ple at heart. But regardless of mo
tives, it can be said with certaint
that not all the answers have ye
been found to the ultimate questio
in the minds and hearts of America
Indians: How can one become a par
of the total American scene withou
ceasing to be an Indian?

It is my sincere hope, bolstered b
meetings with tribal groups durin
the past few months, that a new er
in federal–Indian relations has co
menced—an era in which the e
pressed wishes and hopes of a
Indians will be fulfilled throug
their own active participation in th
making of policy and law.

There are more than 550,00
American Indians in the Unite
States today. Approximately 380
000 of them live on, or adjacent t
Indian lands for which the Secreta
of the Interior is trustee. The B
reau of Indian Affairs is therefo
directly concerned with this group
Indians.

In trusteeship status are mo
than 50 million acres of Indi
lands, stretching from the Flori
Everglades to Alaska. The vast bu
of the holdings is in the weste
states. For the most part these lan
are owned tribally, but individu
ownership is frequent (this is alm
wholly the situation in Oklahoma

The allotments to individu
were made under the Allotment A
of 1887. Its ultimate goal w
to terminate federal responsibili
However, a subsequent law—the
dian Reorganization Act of 193
halted the allotment process, pav
the way for establishment of tri
organization, and broadened fede
responsibility for providing tech
cal and economic aid to devel
tribal resources.

For the sake of easy discussio
is commonly said that about 250
dian reservations are still in e
tence. These range from the v
Navaho territory—24,000 squ
miles—to the tiny rancherias of C
fornia, which are gradually be
terminated under a 1958 law.
told, approximately 700 differ

tribal groups are eligible for federal service; these include the many far-flung village groups of Eskimos, Aleuts, and Indians in Alaska.

am of those people. . . .
have known the pangs of trying
live in two worlds,
derstanding one with my heart,
e other with my head.”

Many Indians remain much as Alexis de Tocqueville saw them more than a century ago—“a people apart.” The population has mushroomed since the turn of the century, d its birth rate is now nearly dou- e the national birth rate. The land se of most reservations is too small support the population. Many of e reservations are in depressed eas of the country, and become ubly conspicuous as pockets of verty in regions already economi- lly limited. Average family in- me on the reservations is less than ,000 per year—below the “poverty e” of $3,000 established by the fice of Economic Opportunity. blessness may range from 40 per nt to 80 per cent, depending upon season and the locality.

Many of the Indian land areas e potential for development far ond the present level. The Bureau of Indian Affairs has made an intensive effort to attract industries to reservation areas, and about 80 are now established. In recent months, electronics firms have become highly interested in Indian workers, whose manual skills and attention to detail make them highly sought after for precision work.

At the same time, the Bureau has concentrated heavily on educational opportunity. During the past five years, about $500 million has been appropriated for school construction and improvement of programs in federally operated schools for Indians. Some of these funds have also gone for aid to public school districts serving Indian children, and there has been an acceleration of grants and scholarships for higher education. For example, scholarship funds are now an integral part of many tribal budgets.

“A Culture of Poverty”

Still, the Indians of the reservation communities remain among the lowest on the scale of social and economic progress in recent years. A culture of poverty has contributed to the dependency attitudes that characterize many of the people of these isolated communities.

I am of those people. I grew up on the Oneida Reservation in Wisconsin. I have known the pangs of trying to live in two worlds, understanding one with my heart, the other with my head. In my new role as Commissioner of Indian Affairs, I am trying to open the doors wider to the Indian people than ever before; to give them the opportunity to become the decision-makers, not merely the passive followers that they have been for so long.

On April 27, 1966, when I was sworn in as Commissioner, President Johnson said to me:

“The time has come to put the first Americans first on our agenda. Begin work on the most comprehensive program for the advancement of the Indians that the government of the United States has ever considered. I want it to be realistic, progressive, venturesome and farsighted. I am going to depend on you to tell me what needs to be done not only by your Bureau but by the other departments and agencies in this government. If you fulfill this charge, you will have the full power of the institution of the Presidency of the United States behind you.”

This is a heady challenge. Without the active participation of the Indian people, no Commissioner of Indian Affairs could hope to meet it.

It is for this reason that the past few months have witnessed a series of meetings with tribal groups in the various parts of the country where Indian population is concentrated. These meetings have helped provide the insight to develop far-reaching legislative proposals that will be offered to the 90th Congress. We hope this Congress will become known among American Indians as the one that loosened the shackles binding 380,000 or more citizens in a condition of benevolent oppression.

Never before has the government actively sought the recommendations of Indian groups on the making of legislation. Tribal leaders have told me they regard the meetings as an “expression of faith” by the federal government in fulfilling its moral and legal responsibilities.

The Reservation Indian

The issues and the problems are manifold, and for the most part they derive from the trusteeship status of Indian lands. The advantages to the Indian in this trusteeship situation are protection of title to his land and freedom from land tax. But the disadvantages are many: The tribe or individual is not allowed to dispose of lands without approval; development is inhibited by inability to mortgage trust properties for investment; with land passing from one generation to the next, fractionated ownership has resulted in high costs to the federal government to administer parcels that offer little income to any single individual.

The trusteeship responsibility of the Secretary of the Interior includes responsibility for overseeing the use of Indian monies. During the past few years more than $200 million has gone into the Treasury in the name of numerous tribes—awarded by the Indian Claims Commission in tribal suits against the United States for lands taken in the last century. Moreover, the development of Indian lands, although still insufficient, has resulted in many more millions to certain tribes—from mineral leases, lumbering, ranching, and commercial farming. The use of these funds is subject to review by the trustee. Trustees are noted for their conservatism, and the tendency to gamble is not one of their traits. Yet investment "risk-taking" is one of the things that tribal governments must do if they expect to get maximum returns from their estates.

There are ways that the trusteeship hold can be relaxed, while still protecting the less financially sophisticated tribal groups. Behind the problem of restrictive trusteeship patterns, however, is the problem of Indian uncertainty. Generally, those who still cling to reservation life fear a termination of federal responsibility, knowing full well that they are not equipped to compete unguided in the complex socioeconomic structure of the outer community. This fear should be seriously considered in any efforts we make. It is not a groundless fear. It is rooted in a sense of reality. It is one of the prices that the Indian people have had to pay for clinging to the remnants of a culture that faced obliteration.

"It is my sincere hope, bolstered by meetings with tribal groups during the past few months, that a new era in federal–Indian relations has commenced. . . ."

The average reservation Indian—including those who leave the reservation but still "think" reservation—is alive because the previous two or three generations clung, for sheer survival, to a way of life they understood. The reservation Indian today is confronted with a dawning realization that not all of the old way of life is practicable; yet he does not have the breadth of experience to make a happy adaptation between old and modern. The burden is particularly upon the shoulders of the young people, who need to know who they are and where they are going. Bewilderment is great for the Indian youngster who has lived most of today's common experiences only vicariously, through movies and television, through an occasional trip to town, and through readings in his school books.

The Indian Bureau's history of protective paternalism has also been one of unilateral concern for the welfare of the Indians of this country. For decades it was the only government agency that assumed any responsibility for their welfare. State governments usually maintained a hands-off policy. Local governments decried the lack of tax revenue from Indian lands and therefore took the position that their responsibilities did not extend to Indians.

But times have changed. The fed-

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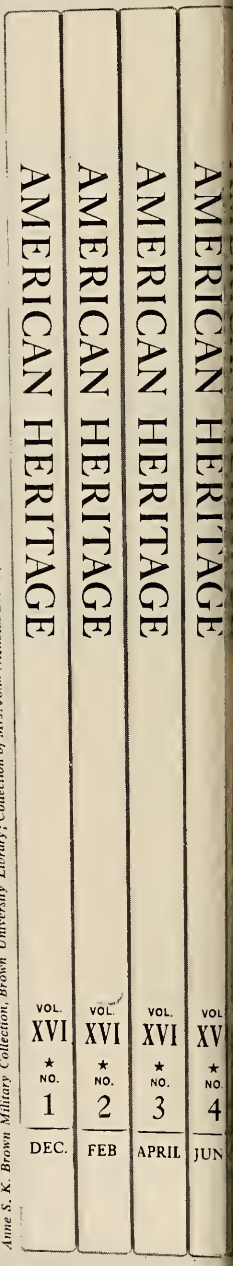

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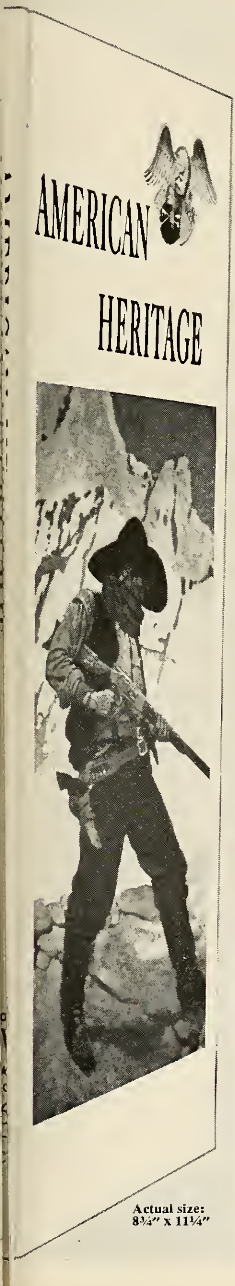

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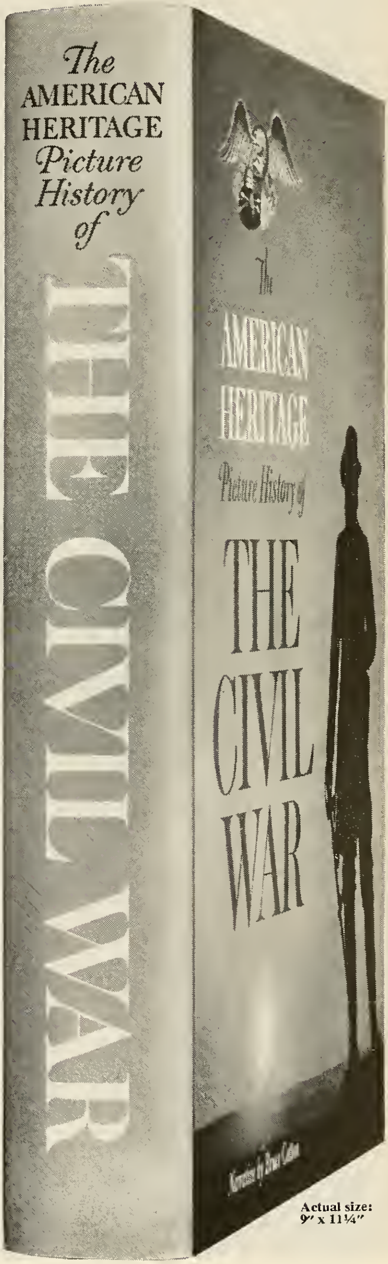
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eral government now operate through myriad agencies to improv the health, welfare, education, an working opportunities and cond tions of all Americans. The bulk c federal expenditures is channele through the states. The Bureau c Indian Affairs is no longer alone i its concern for Indians; therefore is time for its role to change.

A Different Approach

The new era is already emergin The Bureau is becoming an "ur brella agency" for co-ordinatir government efforts in behalf of tl Indian people, rather than a "sec rity blanket" for tribal group Reorganization of the Bureau taking place right now to give prop recognition to the importance educational opportunity; to provi for close and continual liaison wi federal, state, and local agencie and with lay groups interested Indian affairs; to hasten econom development of Indian resource and to prepare Indian people f the day when they will want to fur tion as communities within t framework of our American syste

The pace was set by Congres by the Appropriations Committe and the Committees on Interior a Insular Affairs of both Houses; individual Senators and Represen tives from "Indian country" w responded to the voices of th Indian constituents; and by otl individual Congressmen reacting the increasingly insistent demand the general public that full soc and economic opportunity be p vided to their Indian fellow citize

In the last half-dozen years Co gress has appropriated $1.5 billi for aid to Indians. Also, last Oc ber 13, several members of Congr introduced a bill to provide fo White House Conference on Ind Affairs. On the same day, three them introduced a resolution Con. Res. 114) with far-reach implications. Referring to "the plorable conditions of American dians and Alaska Natives," it cal for "a sustained, positive and namic Indian policy . . . offering s determination and self-help featu for the people involved." It rec nized that the new national Ind policy should be continued "u the day when the nation's moral legal obligations to its first citiz

—the American Indians—are fulfilled." It went on to declare that their property be protected, that their culture and identity be respected, and that the Secretary of the Interior should periodically review the situation, submitting to Congress an annual report indicating the manner in which the intent of the resolution is being carried out.

This Congressional interest and concern set the stage for widespread response from tribal leaders to the invitation from the Indian Bureau to meet recently for the purpose of creating new legislative proposals.

The meetings, each lasting three days, were held in eight locales—Washington, D.C., Minneapolis, Spokane, Oklahoma City, Albuquerque, Las Vegas, Billings, and Juneau. Represented were tribes in Michigan, Wisconsin, Iowa, Minnesota, North and South Dakota, Nebraska, Montana, Wyoming, Florida, Washngton, Oregon, Idaho, Oklahoma, Kansas, Mississippi (Choctaws), New Mexico, Colorado, Nevada, Utah, California, Arizona, and North Carolina (Cherokee), and native Alaskan representatives from Eskimo, Indian, and Aleut villages. n all, more than 1,000 Indian repesentatives attended.

These sessions gave tribal delegates a forum for airing their major concerns as well as a chance to recommend new programs and policies o shape the future in federal–Indian elations. The meetings were well imed. They have helped the Indian Bureau shape legislative proposals nto final form for the 90th Congress, which convened this January.

The major problems presented by ach tribal delegation tended to fall nto these general categories: low ducational levels, substandard ousing, poverty and unemployment, health and sanitation needs, and problems resulting from fraconated ownership, and economic evelopment of the reservations.

It is difficult to assign first priory to any of these problems, and ot realistic to believe that all will e solved in a hurry. But of this we re certain. Now that all three voices -the Department of the Interior, the ongress, and the Indian people—re speaking similarly of "the delorable conditions," a new era is ideed dawning for America's "first tizens."

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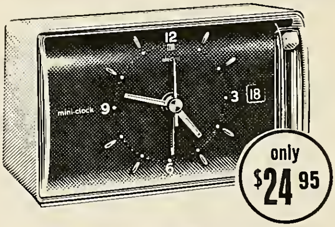

They're the same people who don't mind living with "the approximate" time or walking into a Five-and-Dime every six months to buy another new $8.95 wind-up tick-tock.

Also, this clock is not "just" a clock. It is a most elegant tabletop timepiece from West Germany with the following attributes:

There is the calendar. When you wake, you'll know what day it is! (This sometimes comes in handy!) Around back you will see no handle for winding . . . no cord for plugging-in. An ordinary flashlight battery powers the mechanisms—for a good year or more. When it begins to lose its juice, red appears under the number "12". Now, about the alarm. It's not the alarming kind. Just effective. Reveille begins with four short but insistent signals. If you don't shut off the alarm, there will follow a continuous bzzzzzzzzz that would stir Rip Van Winkle.

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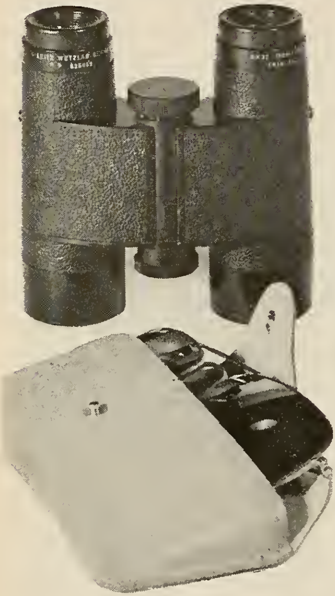

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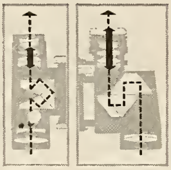

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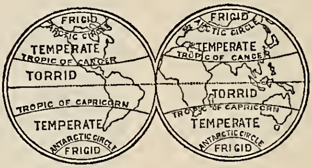

A Naturalist at Larg

The editors of NATURAL HISTORY asked me if I would undertake to write a monthly column for the magazine—dealing with anything that seemed appropriate or interesting. They acted as though they expected difficulty in persuading me to do this, but who could resist the chance to air ideas and experiences regularly to just the kind of people one is always trying to reach with books and occasional articles? There was no problem of persuasion.

What should the column be called? My first thought was the title that Thomas Barbour used for his autobiography, published back in 1943, *Naturalist at Large.* Tom Barbour was for many years director of Harvard's Museum of Comparative Zoology. He was a large man, with large ideas, who had traveled largely. I think this last was on his mind when he chose the title, but I have always envied it and mean to honor him by using it. There is no copyright on titles, but it would be confusing to use it for another book, and hardly fair to a man whom I admired greatly and who was in part responsible for steering me into a career in science—in natural history.

"Natural history." What a grand and proud label! Turning to *Webster's Third New International Dictionary* I find: "A former branch of knowledge embracing the study, description, and classification of natural objects. . . ."

"Former" indeed! I haven't checked back to see who was responsible for editing the scientific terms in that dictionary, but I suspect it was someone who felt more at home with test tubes than he did with li
ing animals and plants.

When I really want to find o
about a word, I still depend chief
on that stately row of volumes *Th*
Oxford English Dictionary, affe
tionately known to all scholars
the "OED." Pulling down Vol. V
(*N-Poy*) I am more comforted: "
work dealing with the properties
natural objects, plants or animals;
scientific account *of* any subje
written on similar lines." (Why
"of" italicized?)

A naturalist is a student of nat
ral history: perfectly simple. But t
word has such a great history th
it took me a long time to gain t
courage to use it. It has characte
ized such people as Charles Darwi
Thomas Huxley, Alfred Russel W
lace, and Henry Walter Bates (
relation). Yet, after all, to be a nat
ralist doesn't mean you have to be
great one, and for some years no
whenever I have encountered a fo
on which you have to fill in son
thing for "occupation" or "prof
sion," I have written "naturalis
with no qualms. (Where there is
blank for "race" I have always be
tempted to write in "human," bu
don't remember that I have ever c
ried through.)

As for the "at large" in the c
umn heading, I suppose it mea
"on the loose," since the editors ha
placed no restrictions on what
should write about. Right now,
chief preoccupation is winter, an
might as well start by writing ab
that or at least about the curic
terminology of the geographers.

I was brought up in south

hese Bronx teenagers have
und a peaceful way to fight in Vietnam.
ut they need your help.

ones Wong, Janet Crawford and
ert Cirkiel are three of the lead-
But there are 2400 more like
n at Olinville Junior High
ol in the Bronx. The youngest
. The oldest, 15. All of them are
ng a Vietnamese child and his
y in their fight against hunger
lespair.

ast year, the student council at
ille voted to share some of its
fortune with a Vietnamese
and family struggling to sur-
in a refugee camp. Through
The Children Federation
re giving $15 a month to help
guyen Huans—a family of five
two sons, eight and four, and a
ter six.

he Huans lost everything in
ar and for two years have been
ig a tiny room with another
y. There is no privacy, no elec-
, no running water, and one
loaf of bread between them.
ather works as a laborer for
day. The mother spends her
ollecting firewood for cooking
eat. And the eight-year-old son
care of the two little ones.

The $15 each
month provided
by the children
from Olinville
Junior High has
already had star-
tling effects. It
is providing the
s with desperately needed
s and food. With a small loan,
ther has been able to start a
store in the family's half room.
oney left over, together with
provided by other American
rs, was borrowed by the refu-
mp to help build a community
t place and, most important,
ol. The Huans are still a
ay from winning the battles
t hunger and poverty. But
is giving way to hope.

ace may one day come to Viet-
ut for hundreds of thousands
entual solution won't help
they get food and clothes
ow, and a reason to believe
future will be brighter. Your
needed to give them a little
boost to help them to begin helping themselves.

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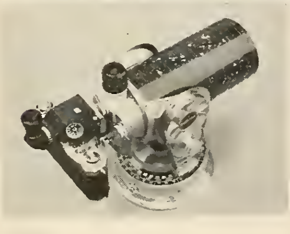

Another great bird photograph demonstrates the resolving power of Questar which reaches out to capture distant wild life in such sharp detail that it might be but a few feet away.

In the cover shot at left, the arrow points to the little blue heron caught in a dramatic pose on the dock. It is 200 feet from the Questar Field Model shown in the foreground with the Nikon camera attached and mounted on the Linhof Heavy Duty Professional Tripod.

Exposure 1/125 sec., on Plus-X film.

Below, the Nikon F Photomic-T camera is attached to the Standard Questar, which is fully mounted to be used on any sturdy table or other handy flat surface and can eliminate the need for a tripod. The right-angle viewer on the camera is extremely convenient with this set-up.

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QUESTAR

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Florida; my first job out of college was with the United Fruit Company in Honduras and Guatemala. I have spent much of my life since then in the tropics—and always loved it. We lived for eight years in a little Colombian town named Villavicencio, at the headwaters of the Orinoco on the edge of the eastern Andes. *East of the Andes and West of Nowhere* was the title my wife used for a book she wrote about our experiences. We were 4 degrees north of the Equator, and visitors used to ask us if we didn't miss the changing seasons: we didn't miss them a bit. But problems like schooling for the children eventually led us to move north to a university town, where daddy became a professor (although I still have a tendency to flinch when people call me by that title).

The intellectual climate of Ann Arbor is fine: my colleagues and the students are endlessly stimulating. But I have never been able to think of anything nice to say about the weather, especially between October and April or May. The geographers locate Michigan in the Temperate Zone. But why "temperate"? Of this word, most dictionaries say "neither excessively hot nor cold; mild." And there is usually some further definition like "abstemious in the use of intoxicating liquors." This emphasis on moderation seems singularly inappropriate for a region where a man may suffer from heat prostration in August and frostbite in February. I have never noticed, either that the inhabitants of the regio were particularly abstemious. looked the matter up the other day fortified with a heavy sweater and hot toddy.

It began with the Greeks, o course. Pythagoras developed a theory of the spherical earth about 50 B.C.; Aristarchus, about 300 B.C. described the organization of th solar system, for which we usuall give Copernicus first credit. Eratosthenes in Alexandria, less than hundred years later, applied thes astronomical relationships to earthl map making. He divided the spher cal earth into the five zones that w still recognize, bounded by the line of the Arctic and Antarctic Circle and the two tropics. He called th zones *climata* from the Greek wor for incline, referring to the slope the earth's surface.

The Greeks, of course, were best acquainted with the eastern Mediterranean. They had heard about the frozen seas beyond Thule, and they knew about the cold winters of central Europe. But quite logically, they were not much interested in visiting such barbarous places.

The eastern Mediterranean is mild—as well as relatively abstemious—and might well be called temperate. The Arctic is also, for much of the year, quite appropriately called frigid. As for torrid: the ancients knew the Tropic of Cancer where it crosses the Nile at Aswan, famous now because of Nasser and his dam. Torrid, according to my memory, is a good description of Aswan, at least in midsummer when I was there. With such conditions at the margin of the tropics, it is no wonder that the ancients thought that life might well be impossible because of the heat farther south.

But our knowledge of the earth has widened since the days of Eratosthenes. Temperate may be all right for the eastern Mediterranean, ut it hardly seems descriptive of the limate of New York, Ann Arbor, r Moscow. When you think about t a bit, though, the vocabulary prob- em is easily enough solved: all that s needed is the prefix "in-."

The Intemperate Zone—that's the vay I feel about it in January as I each for a warming toddy. Even he automobiles need alcohol. Birds vith wings and persons with money anage to migrate south. Many ani- als avoid the issue altogether by he prolonged sleep of hibernation. ut the rest of us have to keep going nd stick it out. There are, of course, eople who like winter; skiers and katers like it, and naturalists have fine chance to photograph animal acks in the snow. But I would ather chase butterflies, and my op- ortunities for that are limited.

There are many studies of the eography of temperature, rainfall, d other aspects of climate, but I n't find that any of the sociologists ve carefully studied the distribu- on of temperance in the Intemper- e Zone. In the matter of alcohol, it oks as though there were a nice adient, clearest on the European ntinent, from the light wines of e Mediterranean (with or without sin) to the aquavit of Scandinavia. d toward the east vodka assumes

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its proper perspective during a Moscow winter.

The geologists assure us that present conditions are a transitory phenomenon. For most of its history the earth has had what they call a "genial" climate, with palms growing in Greenland and forests in Antarctica. Some meteorological accident started the accumulation of ice around the poles at the beginning of the Pleistocene, about a million years ago. The peculiar properties of ice, which result in the storage of coldness, have led to the present deplorable conditions of mid-latitudes. As one geologist has pointed out, "The real difference between the center of Africa and the center of Antarctica is that in the former, water is water, and in the latter, water is ice." It is thus perfectly possible that, if we wait patiently for a few hundred thousand years or so, the normal, genial climate of the earth will return. In the meanwhile, we have to get what geniality we can from warming spirits and thoughts of summer.

The annual index for
NATURAL HISTORY, Volume LXXV
(January through December 1966)
may be obtained by writing to:
INDEX
American Museum of Natural History
Central Park West at 79th Street
New York, N. Y. 10024

But such comfort is often transitory. Unable and unwilling to migrate to the tropics for the winter, I solved the problem of life in Ann Arbor a few years ago by bringing a bit of the tropics to Michigan. First we glassed in a screened porch on the southeast corner of the house. This conservatory-like arrangement seemed rather dull, so we started adding birds, lizards, and frogs. This was fascinating, but limited, so we were led to extend into a greenhouse built all along the south side of the house: this, officially, is called my "experimental rain forest." You can sit there under a hibiscus bush and look at that cold white stuff outside, while hummingbirds buzz about your ears. But I'll tell you more about it next month.

Marston Bates is a well-known author who also teaches biology at the University of Michigan. His column will appear regularly in Natural History.

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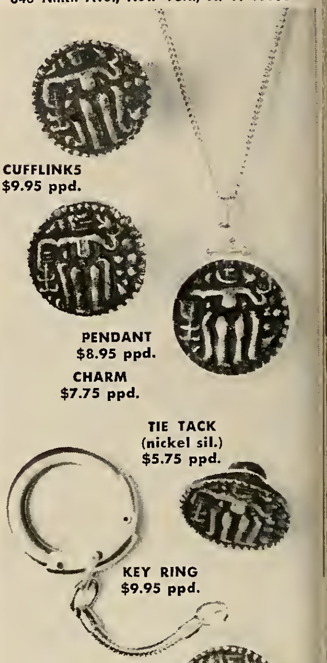

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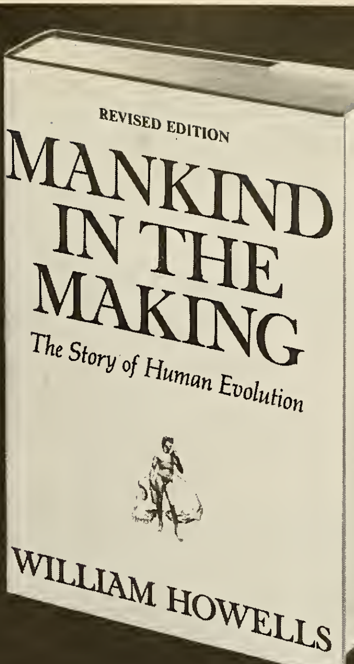
A revised edition of the classic book on human evolution



"The facts bearing on evolution today," William Howells wrote in the first edition of Mankind in the Making, "compared to those known a century ago, are as a whale to a mouse." In the seven years since then, while Dr. Howells' book was becoming the standard in its field, the "whale" has grown considerably larger.

In modifying and enlarging the first edition, Dr. Howells, Professor of Anthropology at Harvard University, has incorporated all that has been learned recently about the subject from finds in Asia, in Africa, in Europe, and in the Middle East.

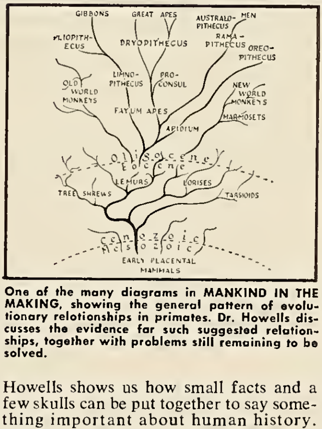
New discoveries and new interpretations

Just one example of these immensely significant evolutionary discoveries are the findings of Dr. Louis Leakey in Kenya. They reveal a great deal about the emergence of primitive man from his predecessors, the man-apes of Africa. At the same time, they tend to show that the date of this emergence was earlier than had been supposed, perhaps 1,500,000 years ago.

In addition, a number of important finds of fossil apes of still earlier stages have been made. One of these may represent man in his earliest recognizable form – perhaps 12 million years ago. Others show some surprising developments among man's predecessors – as early as 35 million years ago. New knowledge like this has changed anthropological thinking.

The marvels of the evolutionary process

The new edition of Mankind in the Making, with revisions and a number of fresh drawings, comprises the most complete, and completely up-to-date, study of human evolution available. The basic concept of the book remains unchanged – to give a clear and understandable picture of the marvels of the evolutionary process by which man has emerged as man. Dr. Howells shows us how small facts and a few skulls can be put together to say something important about human history. Thanks to persistent scientific work, we know how man acquired a skeleton, muscles, and a brain from fish; how he received the gift of locomotion from reptiles; and how, through continuing natural selection in the process of mammalian development, he became warm-blooded, grew hair, and had offspring that are born, not hatched.



One of the many diagrams in MANKIND IN THE MAKING, showing the general pattern of evolutionary relationships in primates. Dr. Howells discusses the evidence for such suggested relationships, together with problems still remaining to be solved.

"Enlivened with engaging touches of wit"

There is nothing "textbookish" about the quality of Dr. Howells' writing. Morris E. Opler, Professor of Anthropology and Far Eastern Studies at Cornell University, has said: "Although Dr. Howells is one of our country's foremost physical anthropologists and writes with the authority and accuracy that specialists will appreciate, he is also one of the most effective interpreters of scientific materials to the general public. He writes with grace and felicity and enlivens his account with engaging touches of wit."

To add to the book's thoroughness, Janis Cirulis has created some 180 stunning line drawings. Included also are eight pages of photographs illustrating racial types, charts, a glossary, and an index.

The eagerly awaited revised edition of Mankind in the Making belongs in the permanent library of every reader of *Natural History*, to be read for the sheer pleasure and intellectual excitement it contains, and also to serve as a comprehensive and authoritative reference. You may examine a copy for two weeks without obligation. If you decide not to keep it, you may return it within that time and owe nothing.

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A new botanical classic

By Edwin B. Matzke

Wild Flowers of the United States, Vol. 1, The Northeastern States, by Harold W. Rickett. *McGraw-Hill Book Co., $39.50; 572 pp., illus.*

Only at intervals of many years are great botanical works published, in any nation. Certainly, *Wild Flowers of the United States* will take its place as one of these. This is the first of five projected volumes. It covers the area from Maine to Minnesota and south to Missouri and Virginia. The second volume will deal with the southeastern flora, and the third, fourth, and fifth with western wildflowers.

This book aims to include all the wildflowers that properly belong in the designated region. According to the author, Dr. Harold W. Rickett, who is Senior Botanist at The New York Botanical Garden, there are some five thousand kinds of flowering plants in the northeastern United States. The present volume does not include trees, shrubs, grasses, sedges, rushes, and a "number of unattractive weeds with small greenish flowers" in which the amateur presumably would have little interest. Flowers that enter the above area but more properly belong in other regions are mentioned but not described. In all, some seventeen hundred species are included, and this certainly embraces those likely to be found.

The book is written in language that can be comprehended by the layman, for whom it is primarily intended. The style is interesting, especially in those parts which deal with the general characters of the families and the genera. "Iris in classical mythology was a goddess whose visible sign was the rainbow; the plants were so called from their rainbow hues." Species descriptions are relatively brief, but they do give the essential and diagnostic features. There is a minimum of scientific jargon, tempered by an illustrated glossary of six full pages, and augmented by five additional pages devoted to the structural features of flowers, inflorescences, fruits, leaves, and stems.

The families of flowering plants are treated in fourteen groups, each comprised of several or numerous families. The sequence followed is not that ordinarily used in current manuals. In the monocotyledons, which are considered before the dicotyledons, the lily family is taken up first in group 1, the orchids last in group 2, and the callas, the cattails and the bur-reeds in group 3. The remaining eleven groups are devoted to the dicotyledons, starting with the lizard's-tail and ending with the daisies. In all, 87 families are recorded, of which 85 receive detailed attention. To facilitate recognition these are arranged in artificial fashion, rather than phylogenetically. The poppy family, for instance, is placed near the beginning of group 5, while the capers and mustards, which are usually thought to be related to them, are in group 6. Similarly, the bluebells are considered in group 11, the valerians in group 12, the lobelias in group 13 (just before the milkworts), the teasels and daisies in group 14. Phylogenetically, these families are usually considered to be not far apart. This book, however, is designed especially for the layman.

There is a chart which guides the reader to the groups, a key in each group which leads to the families, and there are further aids to the genera and species in the families. The plants are designated by the accepted scientific binomial genus and species name, and if there is one, by the common English name. Dimensions and descriptions, the time of flowering, the geographic distribution, and the habitats in which the plants grow are supplied in addition to the diagnostic information. A volume as pretentious as this involves considerable original research on the plants, the results of which are embodied in its pages.

Interesting and informative material concerning many of the genera and species is presented. Thus, in *Solidago* it is stated: "Goldenrods are commonly believed to be responsible for the distressing allergies known as 'hay fever'. Actually not much goldenrod pollen is carried by the wind (the flowers are pollinated by butterflies and other insects) and in the flowering season of these plants the air is likely to contain plenty of ragweed and other pollen known to be the principal cause of the disease."

This volume is illustrated by some 1,200 color photographs, taken mostly in natural settings. These are of great

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– 1967 –

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– EUROPE –

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– AFRICA –

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AUSTRALIA EAST & SOUTH: Barrier Reef, Queensland, southern Australia and Tasmania. Oct. 28; 3 weeks.

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– COMING LATER –

ASIA: (1) India & Nepal; (2) Thailand & Malaysia; (3) Philippines; winter 1968-69. Also (4) Japan, May 1968. Three weeks each.

AFRICA: (1) No. Africa, Atlas Mtns.; (2) West Africa, Senegal to Angola; (3) Central Africa & Madagascar; (4) Ethiopia North. In 1968 and 1969; 3 weeks each. Also see above.

SOUTH AMERICA: (1) Chile & Tierra del Fuego; (2) Argentina; (3) Brazil; (4) Venezuela, Trinidad & Guianas. Also repeat 1967 tours.

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lp in identification and many of them
e superb. In general there is one fig-
e for a species; in some instances
ere are two. They were largely con-
ibuted by amateurs. A list of 51 pho-
graphers is given. Special mention
ould be made of the photographs
ken by Charles Johnson (commis-
ned by The New York Botanical
rden), Samuel H. Gottscho, William
Rhein, and Harold W. Rickett.
any of the finer details are delineated
some 350 line drawings from the
ile pen of Rachel Speiser.

For those who come to scoff—and by
dition a reviewer is expected to give
ne unpleasant evidence of his good
th—the line on the drawing of the
long leaf on page 19 does not point
the midrib, the inflorescence of the
lden-club is more golden, the flowers
quaker-ladies are typically more
te, and the flowers of the fringed
ntian are a purer blue than in the
strations. But these are trivia.

or those who stay to pray, and this
l include just about everyone, the
l-page color reproduction of the
dinal flower is breathtaking, that
the rose-mallow, *Hibiscus palustris*,
dly less so. The photograph of the
key-beard has an almost unworldly
uty and those of the purple fringed
hid, *Habenaria fimbriata*, the twin-
ver, and the brown knapweed are
uisite, to mention just a few among
dreds.

rofessional botanists will still use
tton and Brown's *Illustrated Flora*
. Gray's *Manual*. But they will also
r, perhaps clandestinely, to Rick-
s *Wild Flowers*.

ccording to the Foreword, this proj-
was conceived by Mr. Diarmuid C.
sell, who interested his friends
and Mrs. David Rockefeller in it.
. Rockefeller served as chairman
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ds. Many individuals and a number
rganizations contributed. The vol-
is appropriately dedicated to
vid and Peggy Rockefeller, with-
whose enthusiasm and generosity
e books could not have been writ-
illustrated or published."

n addition to the author, six collab-
ors are listed on the title page. Dr.
iam C. Steere, the distinguished

Continued on page 66

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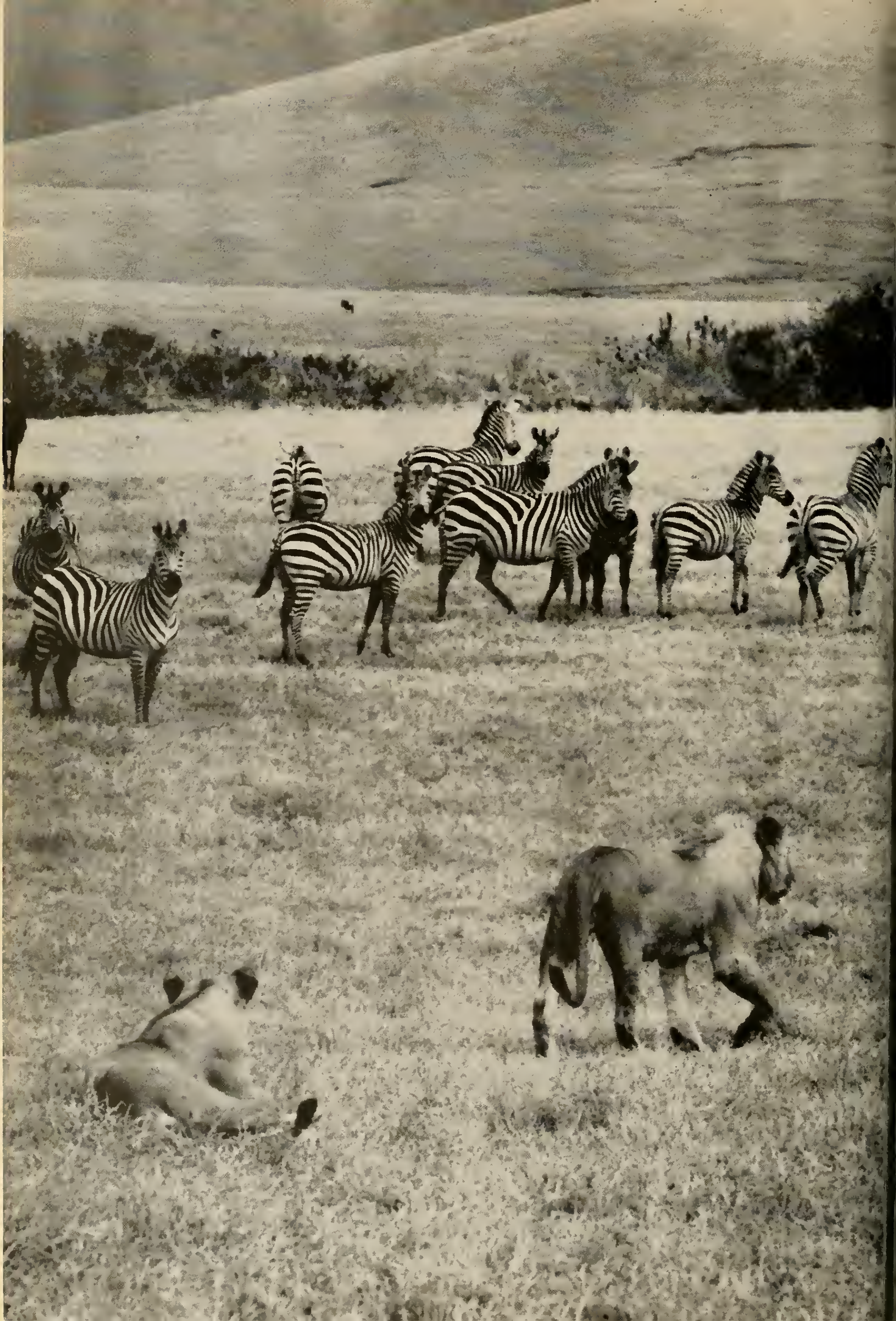


Predators and Scavengers

Stealth, pursuit, and opportunism among carnivores of Ngorongoro Crater in Africa

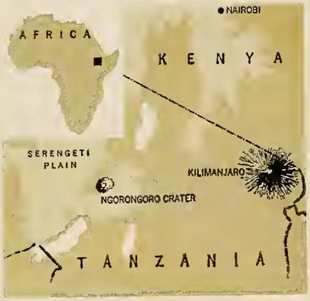
By Richard D. Estes

Each year, as the number of trained zoologists making field studies in Africa multiplies, more and more cherished popular concepts about African wildlife are called into question. Like many popular notions about animals, upon critical examination they prove to be misleading half-truths. Probably no group of animals has been more misrepresented than the predators and scavengers. Lions, for instance, are commonly credited with near-human intelligence in the way they collaborate in capturing prey. Many authors firmly assert that wild dogs operate as a relay team to run down antelopes, and are so fearsome that game will totally abandon an area in which a pack is active. As for jackals and hyenas, they are often pictured as loathsome scavengers on putrid carrion and at lion kills, as camp robbers, and as destroyers of defenseless young and decrepit old. The spotted hyena, in particular, has the reputation of a skulking coward that is capable of biting off natives' faces and snatching unattended babies, but that can be routed by the smallest creature brave enough to stand up to it.

Some of these notions have a basis in fact, but at best they offer mere thumbnail sketches of the variable and complex behavior of these animals. For example, in real life jackals and hyenas—in addition to being scavengers—are also predators. Normally, they greatly outnumber the "big four" among African carnivores—lion, leopard, cheetah, and wild dog—and are quite possibly more important than all these carnivores combined in terms of their effect on populations of prey species. In this article, the ecological roles and behavior of these four "pure" predators are compared with those of jackals and the spotted hyena, in order to show how each species fills a particular niche, and how the dual role of scavenger-predator has the great advantage of opening to exploitation the widest possible variety of food resources. As classic examples of the predator and the scavenger, the roles played by the lion and the spotted hyena will be given special attention.

I had an outstanding opportunity to study predator–prey and predator–scavenger relationships while living on the floor of Ngorongoro Crater, Tanzania, between January, 1963, and July, 1965. One of the world's largest calderas (a volcano that has blown its top), Ngorongoro is a giant "saucer," 10 to 12 miles across, in which live approximately 25,000 large herbivores and over 1,500 carnivores. Not only is it one of the most spectacular places in Africa for viewing wildlife, it is also one of the most rewarding study areas for zoologists interested in the behavior and ecology of large mammals. The Crater is a simplified microcosm of an open-plains ecosystem, so richly endowed with fertile soil and perennial water supplies that game can remain in residence

"After the initial bolt, the herd formed up in a half-circle and stood staring at the lionesses, again from within fifty yards."



throughout the year. Animals can and do move out every November at the beginning of the wet-season dispersal period, by ancient trails that traverse the 1,500-foot walls. But hardly more than 20 per cent migrate, and all, or nearly all, return in May, with the onset of the long dry season. This means that the animals, which must be marked for any detailed study of behavior, can often be resighted year after year for as long as they survive, or for as long as the marks endure. Peculiarities like notched ears, stubby tails, broken horns, and, in species like the lion, even different facial characteristics also serve to identify unmarked individuals. In the more typical plains environment—as, for instance, in the neighboring Serengeti Plains—the huge herbivore populations and many of the predators that depend on them are forced by a semiarid climate to adopt migratory habits, making the observation of marked animals difficult.

The main subject of my research was the white-bearded wildebeest, *Connochaetes taurinus*, an antelope that dominates the great game assemblages of the Crater and the Serengeti Plains. Roughly 14,000 of them live in Ngorongoro—a large number for a 120-square-mile area, but insignificant compared to the 400,000 on the Serengeti. The Crater's four other principal grazers are Burchell's zebra, 5,000-6,000; Thomson's gazelle, 3,500; Grant's gazelle, 1,500; and eland, 350-500. The Crater lacks such common steppe-savanna species as giraffe, wart hog, topi, and impala, but it does support small numbers of Coke's hartebeest, waterbuck, bohor and mountain reedbuck, bushbuck, steinbok, dik-dik, and klipspringer in its high grasslands, marshes, hillsides, and forests. An alkaline lake and perennial springs on the Crater floor support a small hippopotamus population. The cloud forests on the rim and slopes contain hundreds of buffalos, elephants, and more than 100 black rhinoceroses. Rodents and their allies are represented by plentiful populations of mole rats, various mice, springhares, and true hares. There are also some 400 species of birds, notably the denizens of high cloud forest, the water birds and waders, and the grassland species, including the familiar ostrich.

All this abundance and variety of wildlife supports, at the apex of the food pyramid, a considerable number and variety of carnivores, ranging from the arboreal little genet to the lion. Cats, or felids, are particularly well represented, with six species in the Crater, including about 30 lions (down from a usual 60-70 since a biting fly epidemic drove them out of the Crater in 1962), half a dozen leopards, up to that many cheetahs, an occasional caracal, numerous serval, and the ubiquitous African wildcat, ancestor of the domestic cat. There are several species of civets and mongoose, including the marsh mongoose, which looks much like an otter. Of the canine predators, the charming little bat-eared fox is extremely common, and for the last two years a pack of wild dogs has remained in more or less continuous residence.

For all this variety, jackals and hyenas between them account for over 90 per cent of the larger carnivores. Black-backed and golden jackals may number 500 each, and there are between 600 and 900 spotted hyenas. At approximately six per square mile, this may well represent the continent's densest resident hyena population.

Living inside the Crater gave me opportunities to observe predation that are denied to those who see it only by day. For even though some of the carnivores are diurnal hunters, the majority of kills are made from an hour before dark to an hour after dawn. The yaps and wails of jackals and the whoops, roars, and chuckles of hyenas could be heard from my cabin almost every night and led me to many a kill. In the course of making night observations of wildebeest, I often had the chance to follow and watch lions and hyenas hunt. From a hilltop vantage point at dawn, two to six kills made during the final hours of the night could usually be spotted by the seething clusters of hyenas competing for the remains. The sight of wildebeest and zebra all standing erect and staring in one direction revealed the pres-

ence of lions walking, heavy-bellied, toward their resting places. At the same moment the dog pack might be setting out on its morning hunt, its position and course revealed by a bow wave of fleeing gazelles.

From the whole spectrum of predators and scavengers, both mammalian and avian, that live in Ngorongoro, I have selected only those of major importance in the mortality of the larger plains game; a discussion of the smaller predators and the vultures would be beyond the scope of this article. All those selected belong to the order Carnivora: three are felids, three canids, and one, the hyena, is considered to be closely related to the viverrids (civets), although it looks and behaves more like a canid.

It is a matter of adaptive evolution that cats capture their prey through stealth—first stalking or ambushing, then pouncing—and that canids capture theirs by tracking and chasing. These methods are so intimately related to phylogeny that it is possible to reverse the description and say that a carnivore that stalks and pounces on its prey is a cat, and one that trails and runs it down is a canid. The remarkably similar conformation of nearly all cats is thus a proof of basically similar predatory behavior. They are the most anatomically specialized of all the carnivores for a particular mode of predation. The long body; the powerful, quick-reacting (but quickly exhausted) "white" muscles; the relatively short, thick limbs with padded feet and hooked, retractable claws; frontal eyes for good binocular vision; and the short jaws armed with long, stabbing canines are the main specializations that enable cats to stalk so stealthily, to gauge distances accurately, to make a lightning and overpowering surprise attack, and to grip and kill the prey. According to Leyhausen, the German felid specialist, there is even a specific killing bite common to the cats, directed to the back of the neck. However, leopards and lions, and particularly the cheetah, also frequently kill large prey by gripping the throat until the animal suffocates. In either case it is interesting that all cats direct their attack at the front, whereas canids in general attack large herbivores from the rear. The cat is equipped by its claws and powerful forelimbs to neutralize the defensive weapons of its victim, while canids are not. Although less specialized for a carnivorous existence than the felids, canids are nonetheless admirably suited by their wonderful olfactory powers, and by their long legs and deep, narrow chest, to seek out and run down the fleetest prey through superior endurance.

While the basic predatory mode has been determined by common ancestry, each species has evolved its own variation on the family theme. Diversification has even led, in a few cases, to convergence between the two family patterns. The cheetah, for instance, is built more like a greyhound than a cat, has non-retractable claws, and runs down its prey—but only after a preliminary stalk. The wild dog hunts primarily by sight, and jackals, like foxes, usually sniff out and pounce on their prey rather than run it down.

The size of the predator is also

"Although within seventy yards, the cheetah never charged, no doubt because the quarry was aware of its presence."

"Wild dogs are adapted to a pack existence to such a degree that it is questionable whether an individual dog could survive for long on its own."

a primary factor in its choice of prey. The French mammalogist Francois Bourlière has stated that carnivores prey only on herbivores that are approximately the same weight as themselves. While innumerable exceptions to the rule may be cited, particularly when pack hunters are considered, a definite correlation in size does exist. A sound basis for this limitation lies in the enhanced risks of attacking animals too big to be handled safely; natural selection would operate in favor of individuals that stayed safely within their own capabilities. Because lions and other carnivores are demonstrably capable of killing animals very much heavier than themselves, it may be argued that minimization of risks is behind their selection, in normal circumstances, of prey no more than twice their own weight. When dealing with their normal prey, their striking power is so overwhelming that once caught, the victim has virtually no hope of escape or retaliation. Indeed, the apparent helplessness of the victim is one of the most impressive features of African predator–prey relationships. But there is more to it than sheer brute power: it is chiefly the element of surprise on the part of felid predators that disarms their prey, and this is where individually acquired skill counts heavily. Canids achieve the same end of rendering large prey defenseless by first running it to exhaustion.

The "Pure" Predators

Wild Dog

The Ngorongoro Game Biologist, John Goddard, and I have witnessed over 50 wild dog kills, and have thereby gained new insight into prey selection and hunting methods of this most maligned of all African predators. Wild dogs are adapted to a pack existence to such a degree that it is questionable whether an individual dog could survive for long on its own. As a hunting unit, the pack is so successful that the Crater dogs captured their quarry in 85 per cent of all the chases we observed. If they were not so sparsely distributed, this species would be among the most important predators. Yet we saw no evidence whatever to justify the charge that wild dogs kill more wantonly than other predators or that they cause undue disturbance to game.

The pack had two well-defined hunting periods per day—in early morning and late afternoon—and generally made one or more kills in each period. As already noted, wild dogs hunt mainly by sight. Teamwork is extremely important in their hunting system, but not, as commonly portrayed, for running game in relays. As a rule, the pack has a regular leader that takes the initiative in selecting and running down a quarry. He is backed up by one or two others that maintain distances of 100 yards or more behind him, while the rest of the pack straggles far in the rear. The leader has the speed and endurance to run down any African antelope, usually within two miles. Once overtaken, the quarry begins dodging and doubling back, and the dogs immediately behind are then in a good position to intercept it. As the quarry is seized, the pack members close in and quickly tear small prey to pieces by yanking in different directions.

Prominent Mammals in the Ngorongoro Crater

Lion	*Panthera leo*
Leopard	*Panthera pardus*
Cheetah	*Acinanyx jubatus*
Wild Dog	*Lycaon pictus*
Black-backed Jackal	*Canis mesomelas*
Golden Jackal	*Canis aureus*
Spotted Hyena	*Crocuta crocuta*
Thomson's Gazelle	*Gazella thamsoni*
Grant's Gazelle	*Gazella granti*
Coke's Hartebeest	*Alcelaphus buselaphus*
White-bearded Wildebeest	*Cannachaetes taurinus*
Burchell's Zebra	*Equus burchelli*
Eland	*Tauratragus oryx*
African Buffalo	*Syncerus caffer*
Block Rhinoceros	*Diceros bicornis*

In a place like Ngorongoro Crater, at least five or six dogs are necessary to prevent hyenas from stealing their kills, at which they are very adept. Because of hyena competition, and also because both large and small packs tend to kill twice each day, large packs are more efficient and make more economical use of t
prey resource.

Throughout their range, wi
dogs tend to specialize on the m
abundant small- to medium-sized a
telopes. In the miombo woodland
Central and South Africa, the i
pala heads the list. In the East Af
can steppe-savanna it is Thomso
gazelle. Although "Tommy" rank
poor third in the Crater, they ma
up 59 per cent of the Ngorongo
pack's kills, indicating a defin
preference for this species. Inde
leaving out the kills we record
for January, 1965, adult Tommy
counted for 69 per cent of wild d
kills in other months. January w
the month in which 80 per cent
the Crater wildebeest dropped th
calves; during this period the pa
subsisted entirely on this "windfal

Cheetah

Like the wild dog, the cheetah
parently specializes to a consid
able degree on gazelles of the step
savanna and desert in both Asia a
Africa. It is specifically adapted
its build and hunting habits to ru
ning down the fleetest prey of t
open plains, of which none is fas
than a gazelle. In addition to havi
a rather doglike foot with non-
tractable claws, the cheetah is unl
the typical cat in being mainly
diurnal hunter, a special adaptati
to its environment and predatory
quirements. Yet, like other cats,
must have the advantage of surpr
in order to overtake its quarry wi
in the limits of its own maxim
speed; it may be the fastest of
land animals, but it is a sprinter,
a distance runner like the wild d
In the photograph on page 23
adult cheetah is shown stalking
female Grant's gazelle. Althou
within seventy yards, the chee
never charged, no doubt because
quarry was aware of its presen
Nor did the gazelle flee. This s
gests that the cheetah was beyond
distance at which it could expect
run down an alerted gazelle.

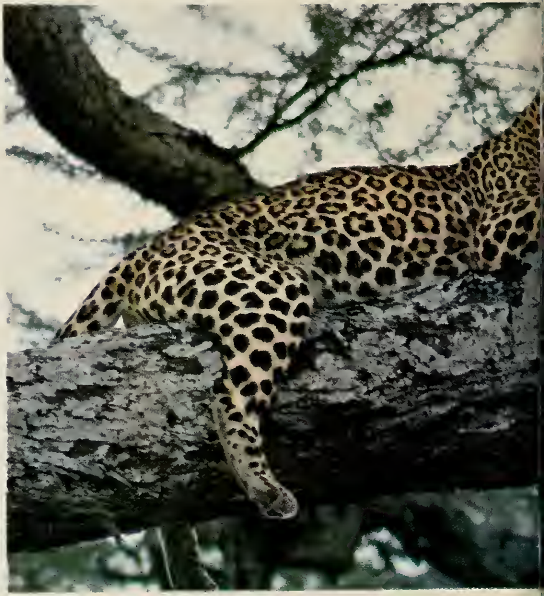
Aside from gazelles, cheetahs a
take small game such as hares a
birds, and the young of the lar
antelopes, up to the size of juven
wildebeest. But, because it is solit
and sparsely distributed over la
areas, this carnivore is only a mi
factor in game mortality.

"The cheetah . . . is built more like a greyhound than a cat, has non-retractable claws, and runs down its prey. . . ."

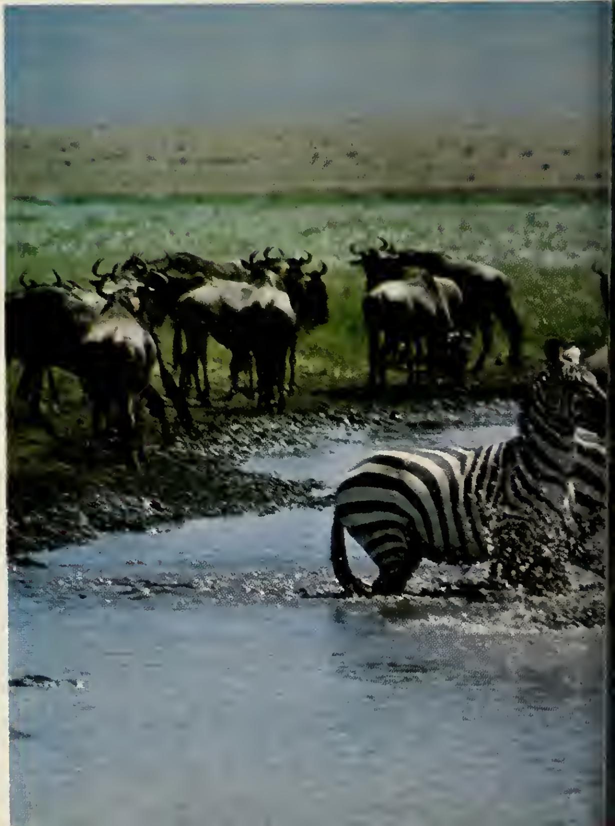
". . . the pack members close in and quickly tear small prey to pieces by yanking in different directions."

Leopard

The leopard is not, properly speaking, adapted to a plains environment. It is really a forest animal that spends much of its time in trees when not actually hunting. Yet wherever suitable cover is found adjacent to the plains, it becomes a predator on plains game. This illustrates the adaptability of this ubiquitous cat, which inhabits the greater part of Asia as far north as Siberia, and almost the whole of Africa south of the Sahara. Unlike the far-ranging wild dog and the cheetah, it is very local in its habits. It can get by in almost any environment that affords enough cover to conceal its presence, and is the only one of the large cats that can persist in thickly settled areas, subsisting on domestic animals when wild game is unavailable. Its natural prey includes everything from birds to baboons and also antelopes up to twice its own weight.



In August and September, 1964, an adult female frequented a grove of fig trees beside the main Ngorongoro watercourse, by means of which a narrow tongue of dense vegetation penetrates into the central grassland. This was where I had my camp. She paid almost nightly visits for a month, adopting as her favorite vantage point and resting place an observation platform I had built in one of the trees shading my cabin. With the help of a flashlight, which did not disturb the leopard at all, I could observe her without leaving my seat. Unlike the leopards depicted in old jungle movies, she never used this perch as an ambush from which to leap upon unsuspecting prey, although she might easily have done so. She always came down to hunt, stealing along the watercourse, or lurking just inside the line of nettles and high brush, as she scanned the neighboring grassland for likely prey. Within a two-week period she succeeded in killing, among other animals, two Grant's gazelle bucks, members of a bachelor herd that often browsed along the edge of this natural ambuscade at night. After throttling them to death, the leopard dragged them back to her favorite tree. Presumably unable to hoist them to the platform—they weighed about 160 pounds each—she left both in turn right beside my Land Rover, returning periodically to eat

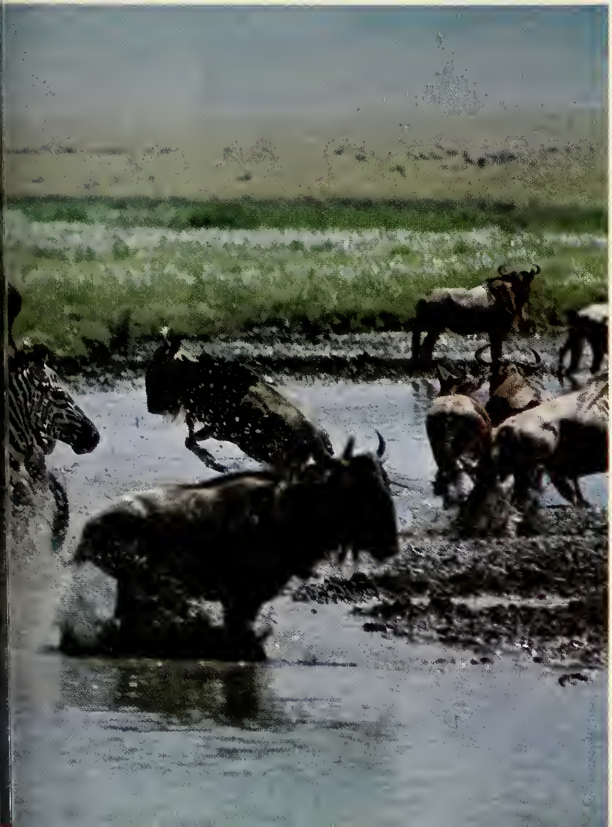


from them. But this leopard's main prey appeared to be jackals, of which she brought back eleven in a matter of three weeks, carrying them up to the platform as a cat carries a mouse, and sometimes playing with them in the same fashion, before finally biting into a vital spot:

The preponderance of jackals in the diet of this leopard is highly interesting in view of the species' notorious predation on domestic dogs, suggesting that jackals or other small canids, where abundant, may be preferred prey. Leopards are also known to take the occasional wild dog. In view of a low population density—the result of its solitary and antisocial habits—and its practice, when undisturbed, of eating from the same kill as long as it lasts, the leopard may be considered highly conservative of its prey resources, and through predation on other predators, as even indirectly benefiting *their* prey.

"Unlike the leopards depicted in old jungle movies, she never used this perch as an ambush from which to leap upon unsuspecting prey. . . ."

"But all plains game, the zebra and gnu in particular, are exceedingly nervous and cautious at watering places. . . ."



Lion

Although the prey and hunting methods of lions have been described in hundreds of books on African wildlife, there is really a decided lack of reliable quantitative information on hunting behavior and prey selection in this species. They have been known to pull down everything from bull giraffe and buffalo to Thomson's gazelle and still smaller game. There are also many reports of lions being killed in encounters with larger game, and in the Crater last year, a lioness who was rash enough to attack a rhinoceros calf was killed by the mother. But here, and perhaps wherever they have the option, lions show a decided preference, first of all for adult wildebeest, and secondly for zebra. In Ngorongoro these two prey species probably accounted for more than 90 per cent of all lion kills.

Much has been made in the lion literature of the wonderfully intelligent co-operation the members of a pride display in the hunt. In a recent issue of *African Wild Life*, for instance, R. H. Ivy describes the way lions collaborated to scare penned cattle into breaking out of their kraal, the male getting upwind and roaring mightily, while the lionesses waited downwind for a cow to jump the fence. Many other accounts also mention the stratagem of a lion showing itself or getting upwind in order to drive game toward hidden lionesses. I don't doubt that lions, being intelligent and sociable carnivores, are capable of this kind of teamwork, although I have never seen an example of it in the Crater. There is no question that members of a pride hunt together, and in fact, the black markings on the backs of the ears look to be specifically adapted to the purpose of maintaining visual contact between them, suggesting that group hunting may be a behavioral trait of the species. But bearing in mind the myth of relay hunting by wild dogs, which started

with the impressionistic observations of early hunters and achieved, through subsequent repetition, the status of established fact, it is only prudent to remain skeptical until all these cherished bits of folklore have been thoroughly investigated by trained field workers. For instance, I have my doubts, shared by some other observers, that lions roar for the specific purpose of frightening game. I have repeatedly observed that the Crater game pay no attention whatever to their roars, and have even played tape-recorded roars at full volume to wildebeest and zebra from forty yards away, without causing any alarm. Also, I have never known hunting lions to make any sound louder than a faint "huh." Nevertheless, I would con-

"Toward sunset . . . the lionesses begin to sit up and take notice of their surroundings, choosing a good vantage point from which they stare long and carefully at distant animals. . . ."

"The male lion, by all reports, rarely hunts for himself, but lets the females do all the hard work, then moves regally in after the kill is made to claim 'the lion's share.'"

ede the possibility of their learning o adapt their roar to hunting in spe- ial circumstances, as when experi- nce proved that roaring was effec- ive in frightening such prey as attle. And this know-how could be assed on to succeeding generations s part of a pride's traditions. But he roar normally functions for in- raspecific communication, perhaps ainly territorial advertisement.

In all the hunts I have observed in the Crater, a single lioness took e initiative in stalking and killing, sually alone, but sometimes backed p by other members of the pride. hat impressed me most was the pa- ence and incredible fussiness they isplayed. On a number of occasions have sat for more than an hour atching a lioness or young lion aiting for a herd of gnus or zebras, ready close, to come still closer to n ambush. Once two lionesses let a le of gnus and zebras trek by with- n fifty yards of where they crouched, plain sight but unnoticed. Sev- al times one or the other tensed r a spring when a member of the le came slightly closer than the rest. ut still they waited, until a zebra nally spotted them and snorted an arm. After the initial bolt, the herd rmed up in a half-circle and stood aring at the lionesses, again from ithin fifty yards. The cats then re- xed, sat up, and looked away with red expressions. Having witnessed is performance every time a con- aled lion was caught in the act, so speak, it is hard to avoid being an- ropomorphic about what looks so uch like a face-saving device.

Judging from this and other occa- ons when lions failed to spring though unsuspecting prey came to ithin forty yards, and also because ildebeest and zebra will stand star- g at them from this distance, it ap- ars that conditions are exactly ght for the spring only if the quar- has its head turned away, so that e lion may launch its charge before ing detected. It is not enough for e quarry to be partly turned and oking away; apparently the pos- bility that it will detect the lion's st move from the corner of its eye nd have time to dodge, get a head- art, or simply be warned is enough put off an experienced lioness. To this convincingly illustrates the overriding importance of surprise in the lion's hunting methods, not only for the initial capture, but also for reducing the risk of self-injury. If not immediately overwhelmed, animals the size of wildebeest and zebra are quite capable of hurting even as powerful an animal as a lion.

The above observations were all made by daylight, when the advantage lies with the hunted rather than the hunter. On the open plains frequented by zebra and wildebeest, there is seldom enough cover for a concealed stalk, so that lions hunting by day must usually wait in high vegetation, often by a watering place or ford, for game to come to them. But all plains game, the zebra and gnu in particular, are exceedingly nervous and cautious at watering places or when forced to enter high grass, as when trekking to and from grazing grounds. Darkness is thus the most favorable time for lions to hunt, and in the Crater probably nine out of ten kills are made at night. The lions are generally inactive by day, lying up in streamside vegetation or in a patch of high grass. Sometimes they lie in low *Erythrina* trees along the edge of the east wall of the Crater. The typical sight tourists see are sprawling beasts dead to the world—"poured out like honey in the sun," as Anne Morrow Lindbergh aptly put it.

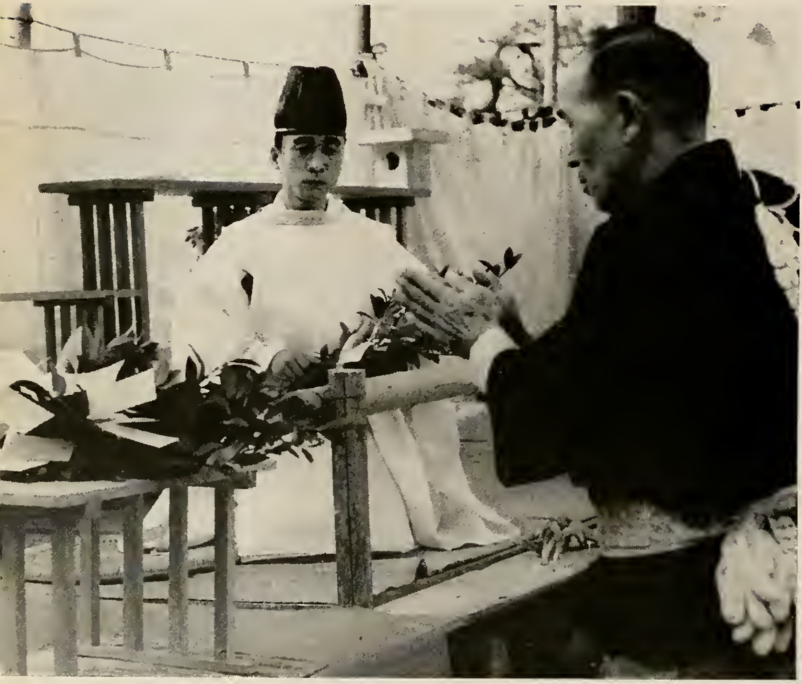
But in late afternoon, the sleepy lions undergo a gradual metamorphosis into nocturnal predators with intent, fierce eyes. The members of the pride greet by rubbing heads and flopping down on top of one another; then cubs and lionesses alike (but not churlish old males) engage in play, ambushing and chasing one another in as wonderful a display of family affection and good humor as can be found anywhere. Toward sunset, if they are going to hunt, the lionesses begin to sit up and take notice of their surroundings, choosing a good vantage point from which they stare long and carefully at distant animals as they evidently size up the possibilities. Shortly before dusk, they start to move down toward the central plain. Here the great concentrations of wildebeest and zebra congregate every evening on the short grass, trekking back in single file from pastures where they grazed during the day.

Often the only game remaining on the outskirts of the main concentrations are a few small herds of wildebeest, hartebeest, and gazelles, and above all, solitary territorial wildebeest bulls that remain attached to the same small piece of ground year in and year out. The entire wildebeest habitat is occupied by territorial males, spaced out at intervals of 60 to 100 yards. Because they are usually alone, and likely to be the first suitable quarry encountered by the lions in their evening movement to the central plain, territorial wildebeest are the most vulnerable of all the Crater game to lion predation, possibly making up as much as 60 to 70 per cent of their kills.

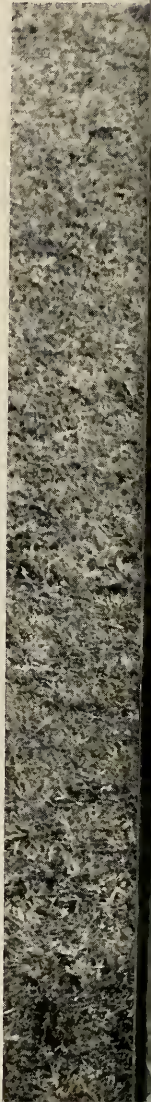
The male lion, by all reports, rarely hunts for himself, but lets the females do all the hard work, then moves regally in after the kill is made to claim "the lion's share." The male, in effect, parasitizes the female whenever the opportunity arises. But obviously, as C. A. W. Guggisberg points out in *Simba*, solitary males or lions in bachelor prides must kill to live, and are undoubtedly capable of hunting for themselves. The biggest lion in the Crater, an old fellow with a short, jet-black mane who frequented the area where I lived, lorded it over two different prides that hunted within his beat. One night, I watched him gorge on a kill made by a lioness from his regular pride. The very next night he was seen on a kill—quite near the first—that had been made by the other pride (which had no adult male). Although still too satiated to have any real appetite, he nevertheless kept the hungry lionesses and their cubs waiting while he leisurely consumed the liver and a few other choice tidbits. Then he stalked off and left them. Judged by human standards, the male lion seems a shiftless bully. But is it reasonable to apply human standards to what is not, after all, an expression of individual "meanness," but a trait shared by all males of the species? It would be more appropriate to inquire about the basis and function of this behavior, for the chances are that it serves some valuable purpose. In fact, this trait can work to the advantage of the pride, for instance in competition with hyenas, as will be described next month in Part II.

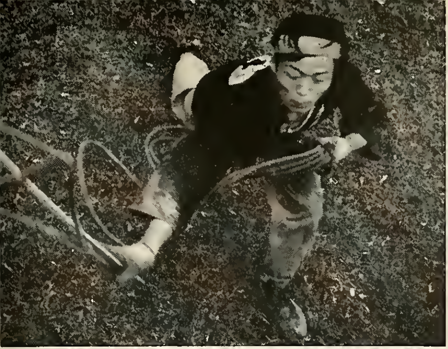
The Antlers of Nara

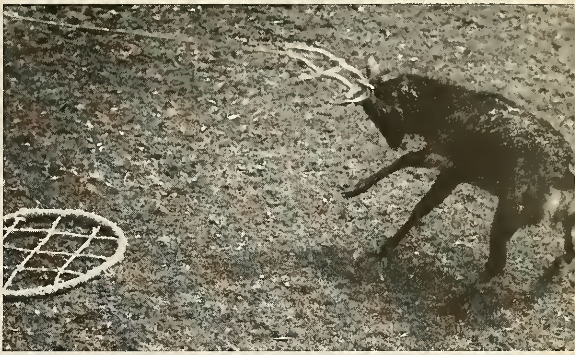
In Nara, an ancient city and the first permanent capital of Japan (from 710 to 784), Buddhist temples and Shinto shrines are still prominent. The Shinto ceremony of removing the antlers from the sacred deer is performed in the deer park here every year. This practice, recorded as far back as 1671, is ceremonially religious, but its purpose is practical. Every fall the mature male deer acquire a pair of antlers that, in the excitement and violence of the mating season, become dangerous. To prevent injury to visitors, the antler removal measure was adopted. The skillful, ritualized surgery has been preserved as a Shinto rite in conjunction with the city's renowned Kasuga Shrine, which considers the deer its sacred creature. The ceremony takes place in the middle of a spacious deer park. Several deer at a time are driven from adjoining grounds to an arena. There, men chase and capture each animal, holding it down while a priest dexterously cuts off the antlers.

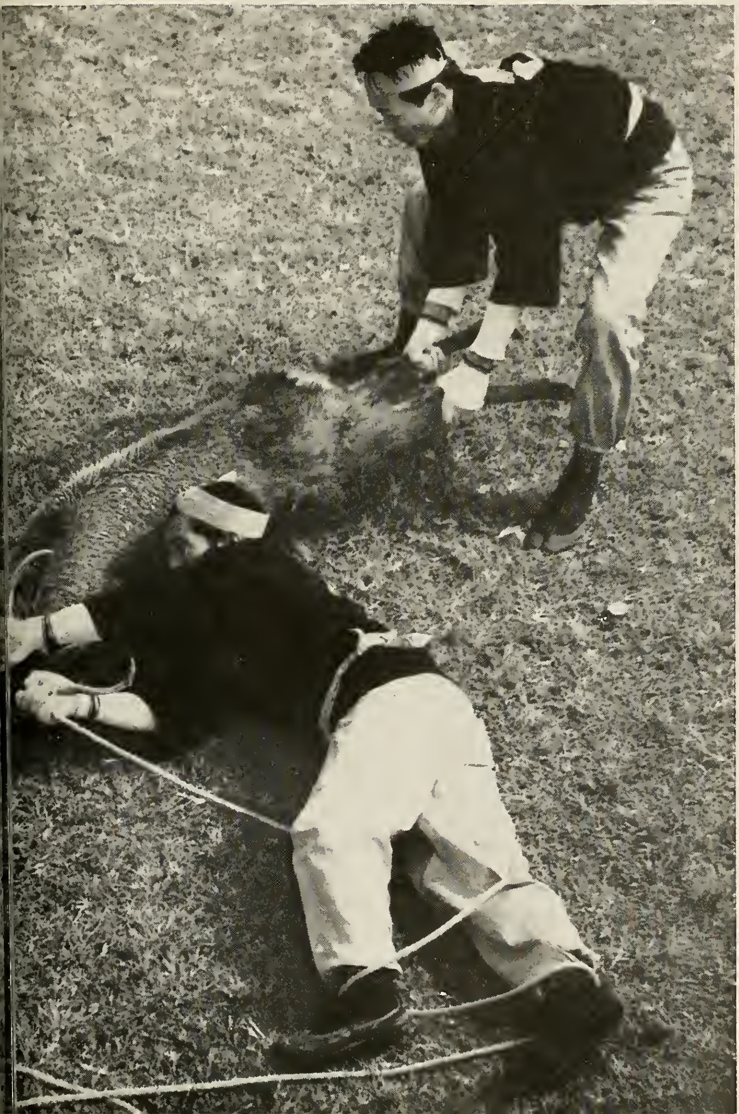


On the autumn day appointed for the antler-cutting ceremony, a representative of the seko (the veteran deer catchers) goes to the sanctum of the shrine to worship before the Shinto priest (in white). The seko will capture the deer with three material aids: asanawa (hemp rope), a juji (crossed bamboo throwing device), and a dampi (bamboo throwing ring with network of rope).



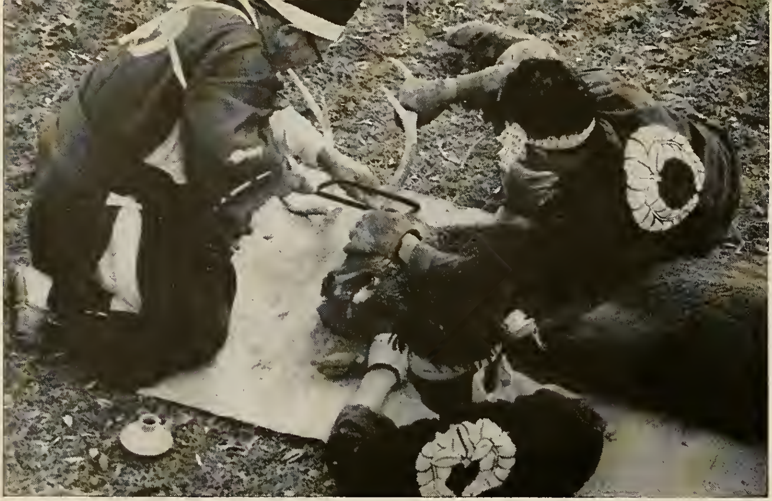






The seko, with asanawa ready in his right hand, throws the juji (above left) and captures a deer by its antler (above). The dampi can be seen lying on the ground. After a struggle, during which the deer usually resists mightily, the seko will draw the rope over to a tree to steady the animal against it, and the deer will gradually become exhausted. He also becomes bewildered as he loses sight of the other deer and sees, instead, only pursuing seko. Eventually a team of two seko manage to bring this now quieted deer (left) to the center of the arena. There the captive animal is held down on a straw mat in the middle of the field, and a partition is set up to keep away the remaining uncaptured deer.

photographs
by
KONOSUKE
MURAMATSU

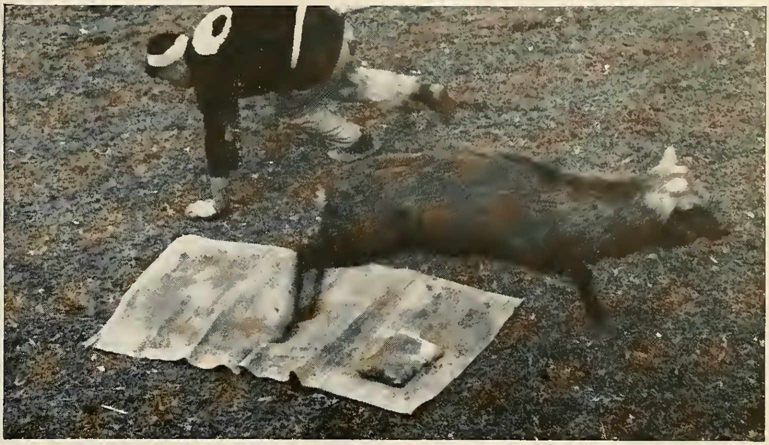


The downed deer is give a drink of water to calm him, after which a speci appointed priest in ceremonial attire begins to saw off the antlers.

All the antlers cut off during the day's rites are offered at the Kasuga Shrine. This part of the ceremony acknowledges the relation between the "patron" creature and the Shrine.

The day's work done, the seko stand together in their uniforms with the priest in his elaborate Shinto attire. Here they receive the appreciation of the Shinto officials.

When released, the deer prings up suddenly and runs ff. The seko must jump up ust as suddenly to get afely out of the way.



NEW IDEAS ON THE RED SHIFT

By Thomas D. Nicholson

As we discussed last month, Hubble's Law provided what seemed to be solid evidence of an expanding universe. It stated that red shifts in the spectra of galaxies increase in proportion to the galaxies' distance from us. It indicated also that galaxies recede at a velocity now accepted as about 19 miles per second per million light-years.

However, the interpretation of the red shift as an actual velocity indicator can be challenged. Indeed, it was even questioned by Hubble himself, and it has again been brought into question in the discussion of the nature and distance of quasars: quasi-stellar objects discovered recently.

When light is considered purely as a wave phenomenon, the interpretation of a spectral shift as an indicator of relative velocity is clear and simple. But light also has some properties that are not wavelike, properties that seem to resemble those of a stream of particles in motion—sometimes called corpuscular radiation. One of these properties is the energy content of light, amply demonstrated in a number of physical experiments and observations. The energy content of light varies with the total intensity of light, as though light were made up of little packets of energy, called photons, each one possessing a discrete amount of energy. But the energy of light also varies with wavelength, even though light of any wavelength travels through space with the same speed. Therefore, a photon of one wavelength contains a quantum of energy different from a photon of a different wavelength; differences in velocity do not exist to account for their different energies. The energy of a photon decreases with an increase in wavelength. In other words, red light contains less energy than blue light.

When light is considered this way—as composed of photons differing in energy content with wavelength—the red shift in the light of the galaxies can be considered in another way. It represents a change in the energy of the light. In other words, the light from the galaxies that we observe on earth has less energy than the same light when it left the galaxies. This could arise from a velocity shift, caused by the actual recession of the galaxies from earth. But it could arise also from some entirely different cause—unrelated to the motion of the galaxies—that caused light to lose some of its energy as it traveled. This possibility was recognized and discussed by Hubble and by others in the years since the red shift—distance relationship became known.

What could happen to light to cause it to lose energy in traveling from the galaxies to earth? Among the several proposals, there are two main avenues of thought. One is that light, in its energy content, possesses some of the characteristics of gravitational mass. In traveling through long distances in space—throughout which there is at least some thinly scattered material—light photons will give up part of their energy to the material they encounter. Even a very slight effect of this kind could account for a large energy loss where the distance traveled and the material encountered was great enough. But the effect could be so slight as to be unnoticed in the relatively small distances within our own Galaxy.

Another proposal suggests that light photons might be subject to a "fatigue" when they travel, as though they encountered a resistance. A variation on this is the suggestion that the energy of a photon may vary with time. In both cases, the time required for light to travel the great distances from the galaxies would result in its having less energy when received on earth than it had when it was emitted from the galaxy of origin, and it would then be observed to have a red shift. The amounts of the fatigue or the loss in energy with time could be so slight as to be undetected in nearby space, but over the millions of years that light takes to travel to reach us from distant galaxies, the effect on the light of the galaxies could still be considerable.

These various theories can, in summary, be referred to as attempts to explain the observed red shift—distance law by a progressive reddening of light with its distance traveled, as opposed to a recession hypothesis, in which the reddening is actually caused by relative velocities of recession in a universe now expanding. To date there has been no generally accepted observational or theoretical

This group of objects in the constellation Hercules includes mostly galaxies and not many stars. The average brightness of these galaxies is evidence of their distance, determined independently of the law of the red shift.

vidence for selecting between the vo hypotheses.

A choice can be made, however, on ie basis of our present knowledge of ature and its laws. Various theories f progressive reddening are based n the existence of physical laws that unnot presently be confirmed or ieasured. A recession hypothesis, on ie other hand, is based on a readily bserved, understood, and measurble phenomenon of nature—the Dopler effect observed in wave motion hen there is a relative velocity beveen source and observer. On this asis, astronomers prefer to accept ie recession hypothesis; to interpret ie red shifts in the spectra of the galxies as evidence of a recessional veocity that increases with distance in n expanding universe. Cosmoloists, however, have still not made a ear choice, for in some of their mods of the universe, a progressive iange in the laws of nature is just logical as a continuing expansion mong the galaxies.

In either case, of course, red shifts, hether they are caused by recession the galaxies or by a progressive iange in the energy of light, can be liable distance indicators, for the observational evidence of the Hubble Law is still there. We observe red shifts, in galaxies for which distances are known, that increase at the rate of a velocity equivalent to 19 miles per second for each million light-years distance to the galaxies. Thus an observed red shift, in the light of a newly observed galaxy, is taken as a measure of its distance. But now even this seemingly valid relationship between red shifts and distance has been brought into question with the recent study of quasi-stellar sources—the so-called quasars.

At first thought to be simply very luminous hot blue stars located in remote regions of our own Galaxy, the quasars attracted attention as being unique when, in 1960, four such objects were found to coincide in position with previously recognized sources of radio radiation. Until then, the sun was the only star that had been observed by radio.

They were of immediate interest to astronomers, for if they were stars, the source of their radio energy must be quite different from the sun's. In relation to the sun, they were powerful emitters indeed: if the sun were removed to the distance of even the nearest star—Alpha Centauri—its radio emission could not possibly be observed on earth. Yet, these stars—for they were still thought to be such—were much more distant than the nearest stars, and they were easily detected by radio. Astronomers at the Mount Wilson and Palomar Observatories began to look for other data about these suspect "radio stars."

It was already known that these objects had peculiar spectra. They showed faint, diffuse emission lines over a continuous background, but these lines did not appear to coincide in wavelength to the known emission lines of the atomic spectra, and the pattern of the lines did not seem to be consistent from one object to another. Then, in 1963, Maarten Schmidt noted something of interest in the spectrum of one of the objects, known as 3C273 (object number 273 in the Third Cambridge Catalogue of radio objects). Four of the emission lines were separated in a manner that resembled the spacing of four ultraviolet lines produced by hydrogen. These are normally invisible in the spectra of celestial objects, since the ultraviolet region where they occur is absorbed by the earth's atmosphere.

But if these ultraviolet lines were shifted toward the red end of the spectrum by 16 per cent of their normal wavelength, they would then appear exactly as they were seen in the spectrum of 3C273. By assuming such a shift, Schmidt showed that two other unknown lines were also identifiable lines shifted by the same amount. Soon, mysterious lines in two other objects, 3C48 and 3C147, were also matched with known lines shifted toward the red end of the spectrum by ever larger amounts.

If these red shifts were taken as Doppler shifts, then 3C273 was receding from earth at a velocity equal to 15 per cent of the speed of light, 3C48 at 30 per cent, and 3C147 at 41 per cent. The only known objects exhibiting such large red shifts were galaxies. If these objects were indeed galaxies, rather than radio stars, the

Five radio galaxies in Serpens are interconnected with unusual clouds, indicating that something peculiar is happening—something future studies may be able to determine definitively.

The most distant objects yet determined are those galaxies in Boötes shown by the arrow. The arrow in the spectrum shows a feature normally located in the blue region, but that has been shifted here to the red by an amount equal to 47 per cent of its normal wavelength, suggesting that the object is located at a distance of about three billion light-years. This is not definite, however, for there is no other evidence of the distance.

In 1963, Quasar 3C273 was the first of the quasars to be identified. Its large red shift brought into question whether the red shift law could be applied to this and other similar objects.

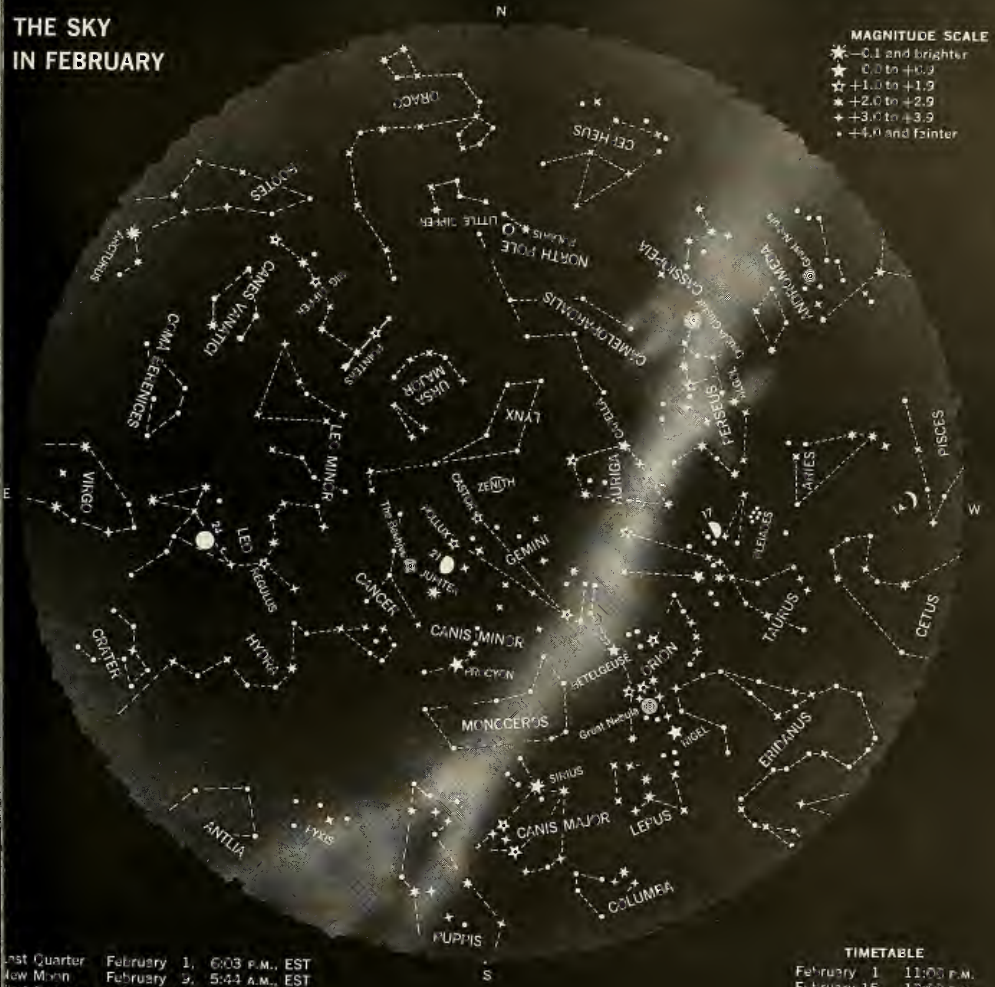
Dr. Nicholson, the regular author of this feature, is also Chairman of the American Museum-Hayden Planetarium

Hubble Law would predict their distances at two, four, and five billion light-years respectively. But at a distance of two billion light-years (predicted for 3C273), a bright galaxy would be barely visible in the largest of telescopes. However, 3C273 was bright enough to be observed in many amateur telescopes. If this object were actually two billion light-years away, it would have to emit many thousands of times more energy than a bright galaxy. If it were indeed a bright galaxy, then at its observed brightness it would have to be much closer. But a bright galaxy close enough to have the apparent magnitude of 3C273 would also be large enough to permit its shape and structure to be observed, and it would not exhibit so large a red shift.

Thus, 3C273, and a few score of similar objects since indentified, were called, for want of a better term, quasi-stellar sources, or quasars. Exhibiting some features that are star-like, some that are like those of galaxies, and some that fit neither kind of object, they may be a totally new and hitherto unknown kind of celestial body. The only clue to their distances, thus far, is the large red shifts they exhibit, interpreted according to the Hubble Constant. But if these are truly unique objects, their large red shifts may arise from some cause that has no relation to their distance. They may be enormously massive objects, several hundred thousand times more massive than an ordinary star, but comparable to a star in size. Light emitted by such an object would have to overcome an enormous gravitational force in order to escape, and the work expended in doing so would appear as a loss of energy, a shift of wavelength toward the red.

As to the nature of quasars, and the correct interpretation of their red shifts, we stand again where we were early in the twentieth century with respect to the galaxies. Time, and a good deal of work, will resolve many of the problems, and in doing so may result in some major revisions in our concept of the universe, the laws of nature that it reflects, and the manner in which it came into its present state.

THE SKY
IN FEBRUARY


N
E
W
S
MAGNITUDE SCALE
−0.1 and brighter
0.0 to +0.9
+1.0 to +1.9
+2.0 to +2.9
+3.0 to +3.9
+4.0 and fainter
DRACO
CEPHEUS
BOOTES
ARCTURUS
LITTLE DIPPER
POLARIS
NORTH POLE
CASSIOPEIA
ANDROMEDA
Great Nebula
CANES VENATICI
BIG DIPPER
POINTERS
COMA BERENICES
URSA MAJOR
CAMELOPARDALIS
Double Cluster
LYNX
PERSEUS
ALGOL
PISCES
ARIES
LEO MINOR
CAPELLA
AURIGA
VIRGO
CASTOR
ZENITH
PLEIADES
17
14
24
LEO
REGULUS
The Beehive
POLLUX
21
JUPITER
GEMINI
TAURUS
CETUS
CANCER
CRATER
HYDRA
CANIS MINOR
PROCYON
BETELGEUSE
ORION
MONOCEROS
Great Nebula
RIGEL
ERIDANUS
SIRIUS
ANTLIA
PYXIS
CANIS MAJOR
LEPUS
COLUMBA
PUPPIS

ast Quarter	February 1, 6:03 P.M., EST
ew Moon	February 9, 5:44 A.M., EST
irst Quarter	February 17, 10:56 A.M., EST
ull Moon	February 24, 12:43 P.M., EST

TIMETABLE

February 1	11:00 P.M.
February 15	10:00 P.M.
February 29	9:00 P.M.

(Local Mean Time)

February 10-12: The early crescent moon moves past ercury, Venus, and Saturn on these days, all three in the vening sky, with the moon low in the west at dusk. The oon passes Mercury at 1:00 P.M., EST, on the 10th; it sses Venus at 4:00 A.M., EST, on the 11th; and Saturn t 8:00 A.M., EST, on the 12th.

February 11: The moon should be easily seen tonight, w in the west after sundown. Look for Venus, a bright tarlike object (about magnitude −3.3) to the right and elow the moon. Mercury is farther right, lower, and much inter (about magnitude +0.2). Saturn (magnitude -1.3) is to the left and above the crescent moon.

February 12: By this evening, the moon has passed Sat rn and will be high in the southwest as dusk settles. Soon fter, you may be able to see the three planets, Saturn, nus, and Mercury, in that order, to the right and below e moon, but Mercury may be difficult to see.

February 16: Mercury is at greatest elongation east of sun, and therefore in best position to be observed. ok for it in the west from about one hour to one hour and 30 minutes after sunset.

February 21: The waxing gibbous moon rises well before sunset tonight, and Jupiter rises with it. The planet will not be observed until dusk, however, when it will be below and to the right of the moon. Conjunction is at 6:00 P.M., EST, when Jupiter and the moon will be closest.

February 22: At about 9:00 A.M., EST, Mercury becomes stationary in right ascension and begins to move retrograde (westward), approaching the sun rapidly.

February 23: Venus has been gradually approaching Saturn all month. It finally catches up today, about 7:00 A.M., EST, when conjunction occurs.

February 27-29: The waning gibbous moon can introduce you to Mars. Look for the bright red planet (magnitude 0.0) to the left of the moon in the morning sky of the 28th, to the right of the moon on the 29th.

All Month: Venus is becoming more prominent in the sunset sky, as are Saturn and (until the third week) Mercury. Jupiter is up in the east at sunset and sets before dawn. Mars rises before midnight and remains till morning.

The dismaying omen was this dam, left, being constructed on the Snake River. It catalyzed the efforts of scientists to save Palouse evidence from inundation.

Cave Life on the Palouse

Salvage archeologists win a race with dam builders in the Pacific Northwest. From a river canyon, diggers bring out the record of a culture that spanned more than 100 centuries.

by GERALD H. GROSSO

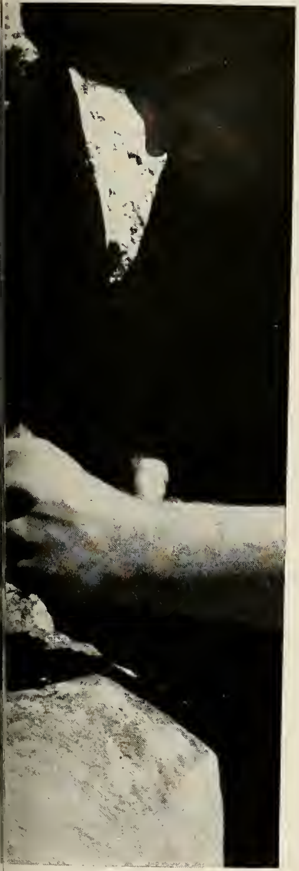
Having done all she could for her dead son, the Indian mother gently laid the still form in a shallow grave at the back of the cave. The father, equipping the untried warrior for the hereafter, placed five matched knife blades alongside the tiny body. Then they carefully covered the baby with earth and stones.

Turning from the grave, the Indians emerged from their rock shelter and returned to the everyday chores of gathering mussels from the river, fishing, hunting, and preparing food. This was life 7,000 to 8,000 years ago below the steep cliffs of the Palouse River Canyon in a remote corner of the state of Washington.

Today's few Palouse Indians no longer dwell in that canyon. The remains of their ancient ancestors have become clues for a team of archeologists working along an obscure river in the southeastern part of the state. The bereaved couple of long ago could not know that their tender act would be unearthed thousands of years later and described as one of the oldest human burials ever found in the Pacific Northwest, or that their child's grave would be counted among the oldest in the New World.

Their story, part of a continuous record of man's life for more than 100 centuries, now is being pieced together after three summers of work by a field crew under the direction of Dr. Richard Daugherty, Professor of Anthropology at Washington State University.

To the casual observer, the Palouse region seems an unlikely spot for early man to have chosen. It is dry and hot in the summer; it can be bitter cold in the winter. The inhospitable brown-black lava rock of the huge Columbia Plateau dominates the landscape, as it has for millions of years. The present-day population, which is non-Indian, is sparse even along the rivers, which here and there course through fertile but narrow flood plains. Of the few families who live there now many do *alvage work resulted in finding many keletons and artifacts at the Marmes ave and other sites. Below, skull of relatively modern child is exhumed.*



without telephone, daily newspaper ervice, or even mail delivery. Buses nd private cars carry their children s much as 75 miles a day to school. n ancient times, however, man's eeds were more basic—simply food, vater, and shelter. And the lower alouse River, where it joins the arger Snake, was a good place to fill hose needs. In fact, a few Palouse In-ians (also spelled Palus) still lived ere as recently as 20 years ago, un-ware of its historic importance.

The area is giving up its archeo-gical secrets just in time. Lower Ionumental Dam is taking shape on e Snake River a few miles down-ream from its juncture with the Palouse. Sometime in 1968, when this dam is completed, the rising water will form a reservoir that will drown the present mouth of the Palouse River. A nearby Indian village site and an Indian cemetery will be inundated, the mouth of the cave will be under water, and any more testimony about the area's early inhabitants will become unrecoverable. Already, dam after dam block the Columbia and its tributaries, providing the Pacific Northwest with new sources of electric power, and transforming the desert of the Columbia Plateau into fertile farmland through related irrigation projects.

But there is another result. These dams, and the lakes that form behind them, are spurring the archeologists in a continuing race with the rising waters. "Salvage archeology" became a way of life for anthropologists in Washington after Grand Coulee Dam created Roosevelt Lake more than 20 years ago.

It is only fair to say, however, that the researchers do not consider the dams entirely bad. Their coming has forced the financing of field excavations that might otherwise have been delayed indefinitely.

The extent of such support is not impressive, of course, in these days of billion dollar projects, but even though the amounts obtained for WSU's archeological work have been as hard to get as seven-figure sums, they have been helpful. Grants from the National Park Service for work at the juncture of the Palouse and Snake rivers—including excavation at the Palouse cave—totaled $12,000 for 1962, $15,000 for 1963, and $18,000 for the 1964 summer's work.

In 1964, Daugherty's program was further strengthened by a $30,000 contract from the U.S. Army Corps of Engineers for a related project: excavating and relocating a modern Indian burial ground. A field school, in which students paid to enroll, raised the on-site crew to 40. That summer's race with the waters was therefore especially productive.

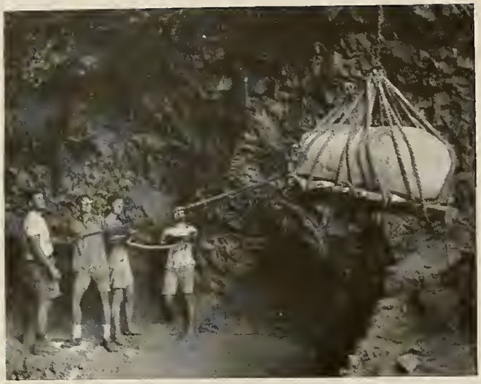
Exploratory excavation of the cave above the Palouse—technically a "rock shelter" because its mouth is about twice as wide as its depth—had started in 1962. Actually, Daugherty's main target that year was the old village. It was chosen because of its location at the juncture of the Snake and Palouse, and was known to have been the Palouse Indians' major village. A preliminary archeological survey in 1948, made in conjunction with planning for Lower Monumental Dam, also pointed to the village as a promising site.

Daugherty, however, knew of the rock shelter's existence from previous treks to the area and decided, since it was only a mile and a half up the Palouse Canyon from base camp, the shallow cave would be worth at least a test excavation by part of his group. In their first week's work they knew they had a potentially rich archeological storehouse—ancient human remains were located in three of the five test pits.

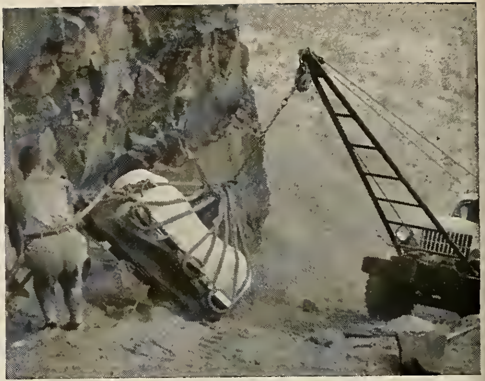
This contrasted with results at the village site. There, diggers found that the ground had been so churned up in the past that modern items were discovered deep in the test pits alongside ancient artifacts. The scientists concluded that disturbance of the site had made it practically impossible to establish a meaningful relationship between artifacts and geologic levels. It was thought best to spend the rest of the summer of 1962 working in the cave, and an extensive series of pits was cut through six to eight feet of the material that had accumulated atop the original cave floor.

This concentrated effort at the cave was rewarded spectacularly. Within two weeks, the exploratory digging had penetrated a layer of volcanic ash, and revealed portions of a human skeleton beneath it. Aware that the ash might have been deposited by fallout from an eruption of ancient Mount Mazama at Crater Lake, Oregon—an eruption known to have occurred about 6,700 years ago—Daugherty realized this could represent one of the oldest human skeletons ever uncovered in the Pacific Northwest.

A long-distance telephone call brought geologist Roald Fryxell quickly to the scene. A staff member of the WSU Laboratory of Anthropology and a specialist in Pleistocene geology, he showed by careful stratigraphic study that the volcanic ash was indeed from Mazama, and that it had covered the skeleton of an unburied adult who died face down on the cave floor. In following weeks the



Up from the floor of Marmes rock shelter, a power winch raises this half-ton "cocoon"—a plaster cast around human bones that remain undisturbed in their protective earth.



The load emerges from the cave. Now the hoisting vehicle will back down to the valley floor and transfer its cargo to a truck for transport to WSU's archeology laboratory.

search was rewarded by locating one skeleton after another. Of these, some had been buried with grave goods and benefit of a small ceremonial fire. When it was time for the diggers to quit their first summer's work and return to school, the rock shelter had surrendered the remains of eleven prehistoric Palouse men, women, and children—including the powdery bones of the infant previously mentioned.

Then at WSU's campus, upstream on the Palouse, at Pullman, began the job of sorting evidence from the sample bags, counting and cataloguing chips of flint, pieces of charcoal, scraps of bone, and mussel shells. Now also was the time to unwrap skeletal material. Because the field camp lacked laboratory facilities, and time was short there, when skeletal evidence was found it was left with its surrounding earth intact for protection. Plaster of paris and surgical crinoline were used to encase the bone-filled earth. The next job—moving the cocoon-like plaster casts—was a nerve-wracking, back-breaking chore: nerve wracking because of the fragility of the ancient bones; back breaking because the larger casts weighed up to 1,000 pounds. Finally, the remains were power-hoisted out of the rock shelter and into a truck for transport to WSU and careful examination in the lab.

Even before this was done it was obvious that the next summer's work should concentrate at the rock shelter. By the spring of 1963, Daugherty was receiving applications from many parts of the country, and from among them he chose a 10-man contingent. In mid-June, the new crew was at the lower Palouse, ready to resume excavation. This time the base camp was set up on Roland Marmes' ranch, with the cluster of tents less than 100 yards from the rock shelter. To get in physical shape for their summer labor, the crew set up tents and flexed their muscles by digging pits for sanitation needs.

After some valuable exploratory work, nearly all digging was concentrated at the shelter. This produced more than Daugherty and Fryxell had anticipated. Instead of "bottoming out" at bedrock, the crew dug down past a bedrock shelf at the back of the cave, through a layer of coarse basalt fragments—and discovered five or six older layers of material.

By the time camp was closed at the end of August, digging had yielded the remains of four more prehistoric residents of the rock shelter. Obviously, much still had to be done before this site could be abandoned to the waters that would fill Lower Monumental Reservoir. It was decided to concentrate again at the rock shelter during the summer of 1964. A cave found across the Snake River would also be tested, and necessary agreements were negotiated to excavate the graveyard near the Palouse village site.

In 1964, with three simultaneous digs in progress, the race begun with dam builders in 1962 had outgrown its simplicity. For the digging and for the field school, a party of forty young men and women were chosen to come to the Marmes ranch. This co-ed aspect ended the free and easy camp life of previous summers. The tent city was not only enlarged but given separate living areas for men and women, as well as an integrated area. Daugherty's wife, Phyllis, joined the group as chaperone and housemother. Now there was not only the cook tent but a larger mess hall tent as well. Electricity brought to the camp along a specially installed power line operated a freezer chest and television set and fed a power-driven screen—built by rancher Marmes and several crew members—tha sped the sifting of every wheelbarrow load of excavated rock, earth and ash produced by field forema Winston Moore's diggers. Electricit also allowed rigging up lights s Fryxell's stratigraphical observation could be recorded in the evening when they would not interfere wit daytime excavation. This meant th geologists' workday might run fro 6:00 A.M. to midnight—but time wa precious in so short a digging seaso

At the graveyard, meanwhile, archeologist Roderick Sprague's cre of nearly two dozen workers was ha ing a busy summer. First, the ol boundaries of the graveyard were d fined by stripping off the sod to l cate the post holes. Then the grav yard sod itself was methodically r moved. The grave-digging India had worked down through wind-deposited loessial topsoil until they struck a hard layer of white lime-cemented soil. But as they dug, some of the lime mixed with the topsoil and, during the subsequent filling, gave the grave a lighter color—a clue hat told the expedition exactly where to dig.

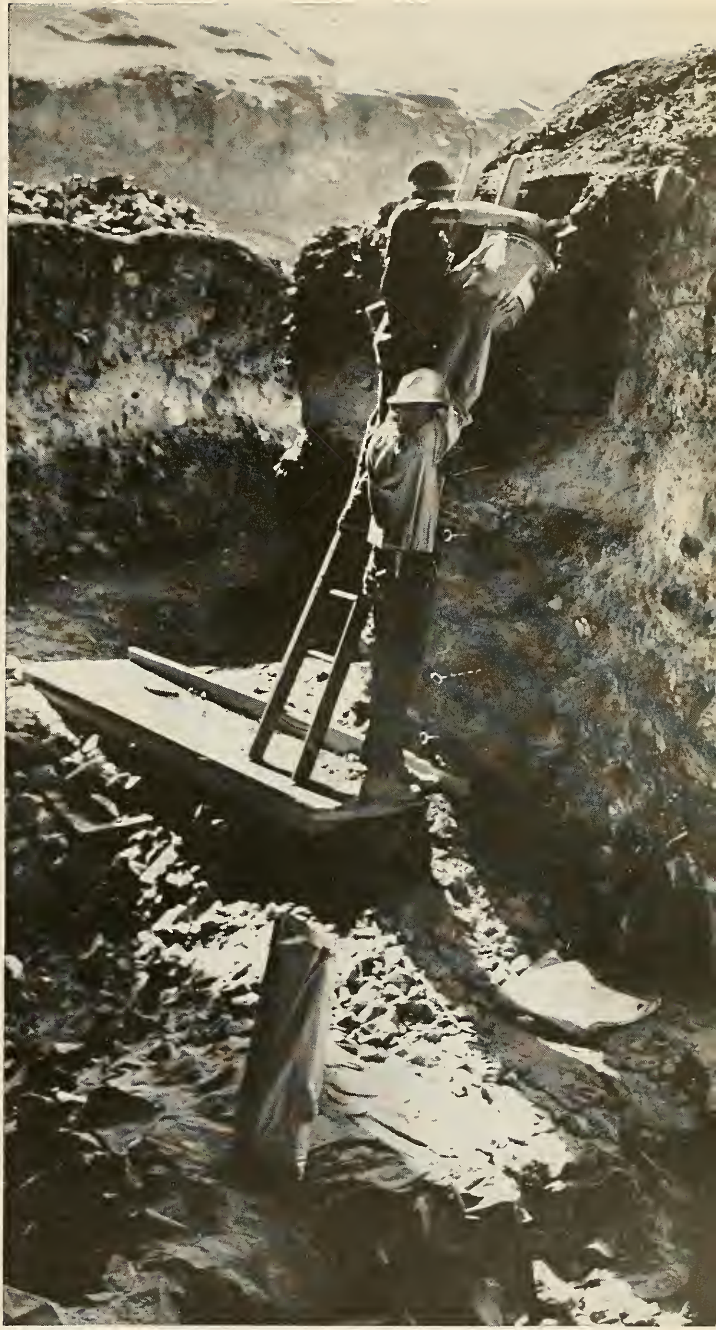
At the beginning, Sprague estimated he would unearth 60 burials. Daugherty disagreed: "You'll find more than a hundred!" Altogether, 251 burials were located and removed during the season. Records were kept of beads, ornaments, clothing, and the orientation of each rave in relation to the sun, river, nd compass direction. Skeletal remains were studied to learn about he age, sex, diet, and ailments of he Indians. A pleasant surprise was finding a "peace and friendship" medal presented to these Indians by he Lewis and Clark expedition a cen ury and a half ago. This is believed o be the fifth medal that has been ound of the dozen made for the ex lorers to take on their journey.

At the same time, archeologist ohn Combes's small crew was work ng through an accumulation of dust nd debris at the remote cave across he Snake River. Their work yielded everal varieties of fiber matting, ome animal paintings on the walls, nd a number of other artifacts.

A high point in the same season as the *in situ* unearthing of still an her ancient burial that was found y workers at the prehistoric dig in e rock shelter.

Actually, it had been located during the previous summer in e bottom of a pit dug into the layer heavy rockfall. Planks and other otection were placed over the urial, and the find was left behind stead of being encased in a plaster st and removed to the lab. In 1964, hen diggers resumed work at the ck shelter, they left the plank-cov ed burial alone for the time being d worked in squares around it. As cavation proceeded, the planks, hich had been at the bottom of the , formed the surface of a shelf.

When time came to bring out frag ents of "Marmes Man," there first s careful work with soft brushes o uncover the fragments of bone. en came a coating of dilute



Inside Marmes rock shelter the control block rose as excavation went deeper into the past. It gave dated samples of small botanical and animal remains. Background shows the steep lava cliffs at other side of Palouse River Canyon.

Elmer's Glue. This preservative was preferred because of the moisture content of the bones—plastic resins don't mix with water and would have given a frosty appearance. Along with this treatment, the fragments of skull, legs, and feet were photographed, sketched on a three-dimensional grid, and carefully labeled and boxed. Several river mussel shells found in layers above the skeleton also were plotted on the grid, then removed for radiocarbon dating at WSU. There, Dr. Roy M. Chatter's laboratory showed them to be about 7,500 years old—meaning the human bones below must be even older.

Further study and evaluation is still in progress. As far as the Marmes rock shelter itself is concerned, the salvage diggers feel they have won the race with the builders of Lower Monumental Dam. A quick, final dig, made at the site in 1965, confirmed that the work here had "bottomed out."

Meanwhile the accumulated evidence has been fitted into a wider picture. Although it has been up to the scientific archeologist and geologist to relate artifacts with geologic time, the Indians themselves have left helpful clues to their long heritage. Lacking a written language, they were storytellers who passed legends from one generation to the next.

One story, describing the creation of Oregon's Crater Lake, seemed total fabrication a few decades ago when man's appearance in North America was reckoned at from two to three thousand years ago. It seems that the chief of the Below World lived inside Mount Mazama. There was a great argument and battle between that chief and the headman of the Upper World. Chunks of fiery rock and clouds of ash were thrown from Mazama, and great tremors shook the vicinity. Finally, the Upper World's headman pushed the top of Mazama down to imprison his enemy forever. The resulting mountains and lake formed Crater Lake.

Typical huddle comes after sifting a load of rock, earth, and ash dug out of cave. Screen is examined for bits of bone, stone artifacts, and other finds.

Re-creating the area's past, geologists have shown that Crater Lake was formed about 6,700 years ago when Mount Mazama erupted violently, emptied its contents over the countryside, and then collapsed. Evidence in the Marmes rock shelter helps to bear this out. About midway down in the excavation is a broad, clearly defined band of fine, powdery volcanic ash, which has been traced to the eruption of Mazama. Signs of human habitation extend for several layers below the ash, proving that ancestors of the Indian storytellers could well have witnessed the mountain's eruption, although their explanation was hardly scientific.

And just what did the digging and analysis reveal about those ancient inhabitants and their culture? A study of the vertical faces of the control block left in the center of the rock shelter showed storage pits, graves, and fire pits piercing several layers. Prehistoric woven grass matting used for lining was still identifiable in some of the storage pits. The diggers troweled and sifted their way through layers of soil particles blown into the cave by the Palouse winds; through sand brought in by stronger winds; through the now compact foot-thick layer of Mount Mazama ash that must have settled in a choking, gritty cloud; then below that, through layers of silt mixed with shells brought by man from the river; and through dirt rich in fragments of animal bone cracked open for its marrow.

From the combined evidence, as well as radiocarbon dating, it was finally clear to the scientists that man first visited Marmes rock shelter between 10,000 and 11,000 years ago.

Carl E. Gustafson, a WSU zoologist, has identified most of the bones retrieved from the shelter. They show that the important food animals for the succession of natives using the rock shelter during the past 100 centuries included mule deer, white-tailed deer, elk, pronghorn antelope, bighorn sheep, the cow, domestic sheep, cottontail rabbits, and jack rabbits. These all represent existing species, but the antelope was not known as a native of Washington in historic times, and the elk is a stranger to the Palouse River area in modern times, although found farther south.

Exposed human bones are painted with a preservative glue. This skeleton was unearthed deep enough in the cave to indicate it was about 8,000 years old.

Other species identified by Gustafson include various rodents. Probably figuring in the food supply for the natives were the marmot and the beaver. Remains of several carnivores—coyote, skunk, and badger—were found in the rock shelter and could have served as food for humans. Analysis of the midden—the concentration of human refuse and cave fill—indicates that early Palouse man went through at least one period when land game was scarce and the rivers were relied upon for most of the food.

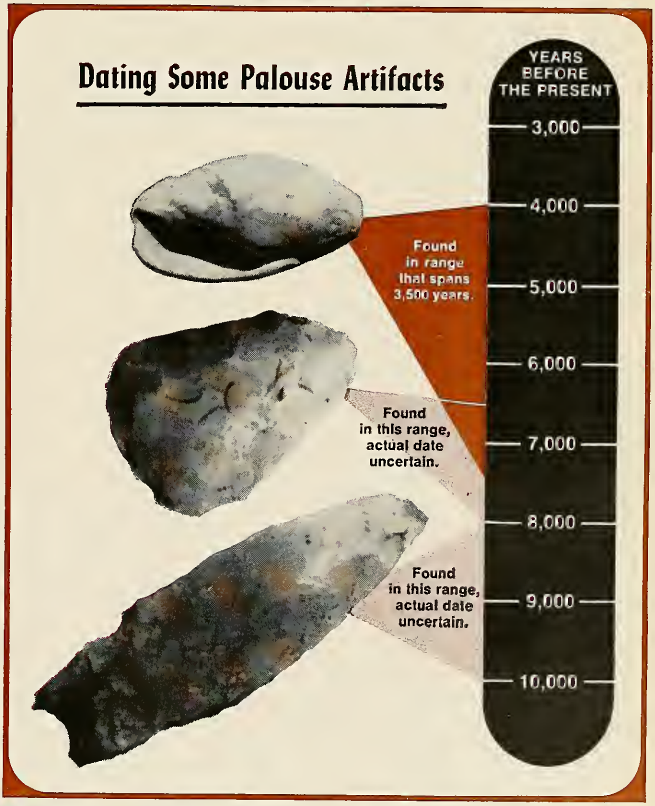
In sum, after studying perhaps a dozen identifiable geologic layers in the rock shelter, Fryxell assigned ages to them, and through the artifacts found undisturbed in them, Daugherty, using radiocarbon dating, has pieced together something of the way the Palouse have lived for the past 10,000 years—a local history of man from bailing wire and cartridge cases back through a variety of handmade stone tools. There is evidence, for instance, that the Indian didn't always use bow and arrow. The early residents employed a throwing stick, an atlatl, to fling featherless, stone-tipped shafts with speed and accuracy. All told, projectile points for weapons used by Marmes rock shelter inhabitants range from the more modern, fancy, corner-notched agate arrowheads, to heavy, side-notched black basalt spear points, to older willow leaf-shaped points with no notches. Below these are still older stemmed points.

Among the earliest points found was one with broad parallel sides, a ground edge, and a half-moon notch at its base. Workmanship on this and other early varieties indicates that the rock shelter inhabitants of 80 to 100 centuries ago had time to seek good raw materials; that the struggle for existence was not so difficult that it destroyed pride in good workmanship.

In contrast to the evolution of projectile points and other tools, the archeologists noted some stability in the presence of a kind of shell found only on the salt-water beaches of the Pacific Coast some 250 miles to the west. The tiny shells could not have provided a worthwhile amount of food; they probably had decorative value. Most are found pierced at the end, apparently for beads, perhaps for "money" necklaces. Other clues to the ancient way of life are scrapers indicating there was the time and the need for preparing hides. A lack of pottery indicates the Indians probably wove waterproof baskets to carry water; flat mortars and pestles show that they ground wild grass seeds, berries, and meat for preservation. Traces on some grinding implements reveal that red and yellow ocher were used for decorative pigments. Leather clothing and water bags also may have been made; some sewing awls of bone have been found.

Because of this area's geologic history, Fryxell believes that no record of human habitation found in the Palouse or Snake River canyons is likely to be older than 18,000 to 20,000 years ago, when the last of a series of great Ice Age floods surged through the canyons and probably carried away any previous human traces. The river beds previously cut into the basalt weren't big enough to handle so much, so suddenly—perhaps 400 cubic miles of water that had been stored in a lake covering most of western Montana. For perhaps only a few weeks, the flood poured across the Columbia Plateau, cutting away most of the present-day Palouse Canyon and, of course, bringing doom to any inhabitants of the Columbia Plateau who chanced to be in its path. Furthermore, even though Marmes rock shelter was formed by flood waters swirling through the canyon, it is unlikely that it or any other portions of the canyon floor were habitable until much later. Following the great flood the canyon of the Snake River was occupied by a long, narrow lake; not until after it drained, probably about 12,000 years ago, could man have moved in to inhabit the rock shelter. However, there may still be found the remains of some individuals who, because they were on a few high promontories, witnessed and survived the flood, or who later lived high on the canyon walls along the ancient lake shore. Therefore, archeologists working some still unfound site may eventually discover that Indian legends about a great flood came from eyewitness accounts, just as those about Mount Mazama now seem true.

Meanwhile, they are concentrating their salvage digging in lowlands throughout the region to beat the new flood of water that will erase what has gone before, as did those cataclysmic floods of the Ice Age.



Examples of artifacts fashioned by the cave's ancient inhabitants are shown here in their relative positions on a chronological table. From the top, in order of antiquity: an olivella shell bead, chalcedony point, and opal point.

MIMICRY

The deceptive way of life

by Miriam Rothschild

Several thousand papers have been published that are directly or indirectly concerned with mimicry. In the face of this appalling volume of literature the amateur naturalist might well feel dismayed—but wrongly so, for this particular field still affords him both the maximum pleasure and the maximum opportunity. Moreover, it requires no expensive apparatus, no elaborate laboratory facilities, no high-powered university education, and not even a particularly high I.Q.! A love of nature and the open air and a talent for keen, careful, and patient observation, coupled with a certain indefinable sense of affinity and sympathy with the animals and plants concerned, are the necessary qualities for success. An irresistible inclination to keep animals in one's own home is also an added asset.

All the original and outstanding discoveries relating to mimicry have been made by the great naturalists. Laboratory scientists have done little more than confirm and occasionally explain—somewhat laboriously—with the aid of modern techniques the theories arrived at by naturalists a century ago. Today the field still remains wide open. Very little is known, for instance, about the habits and behavior of the predators concerned, and when mimicry is looked at carefully, almost every case—even if it can be squeezed into one of the well-known categories—presents a fascinating "special situation" that requires clarification. A few of the problems particularly suited to the naturalist who likes dawdling about on sunny afternoons with a net or watching birds or dragonflies in pursuit of prey are indicated in the following paragraphs.

By virtue of mimicry an animal escapes detection or attack from its enemies by resembling something that is of no interest to them as prey. Thus an insect that closely resembles a leaf may be completely overlooked by an insectivorous predator searching for food, or it may be noticed but actually mistaken for a leaf and thereby escape attack. Similarly, a harmless fly may so closely resemble a dangerous wasp in general appearance that it is deliberately avoided by the predator for fear of being stung. Today the term mimicry is generally used in connection with animals that "imitate" other animals rather than plants or inanimate objects, but this is a somewhat confusing restriction of the term. There are also various types of mimicry, of which perhaps the best-known are Batesian and Müllerian mimicry.

Various animals (insects provide an excellent example) have adopted what may be described as the warning way of life. Having developed some effective protective device, such as a sting, a revolting stink, or a poisonous or highly indigestible body fluid, it pays them to advertise these qualities. Instead of escaping their enemies by evasion and concealment they call attention to themselves (and simultaneously to their dangerous attributes) by bright colors, sound emissions, or a conspicuous "exhibitionist" type of behavior. A bird that has had one or two disagreeable experiences learns to avoid such brilliantly colored insects. The slow flight, for example, of the monarch butterfly (*Danaus plexippus*) affords the predator time in which to examine and recognize it, and refrain from attack.

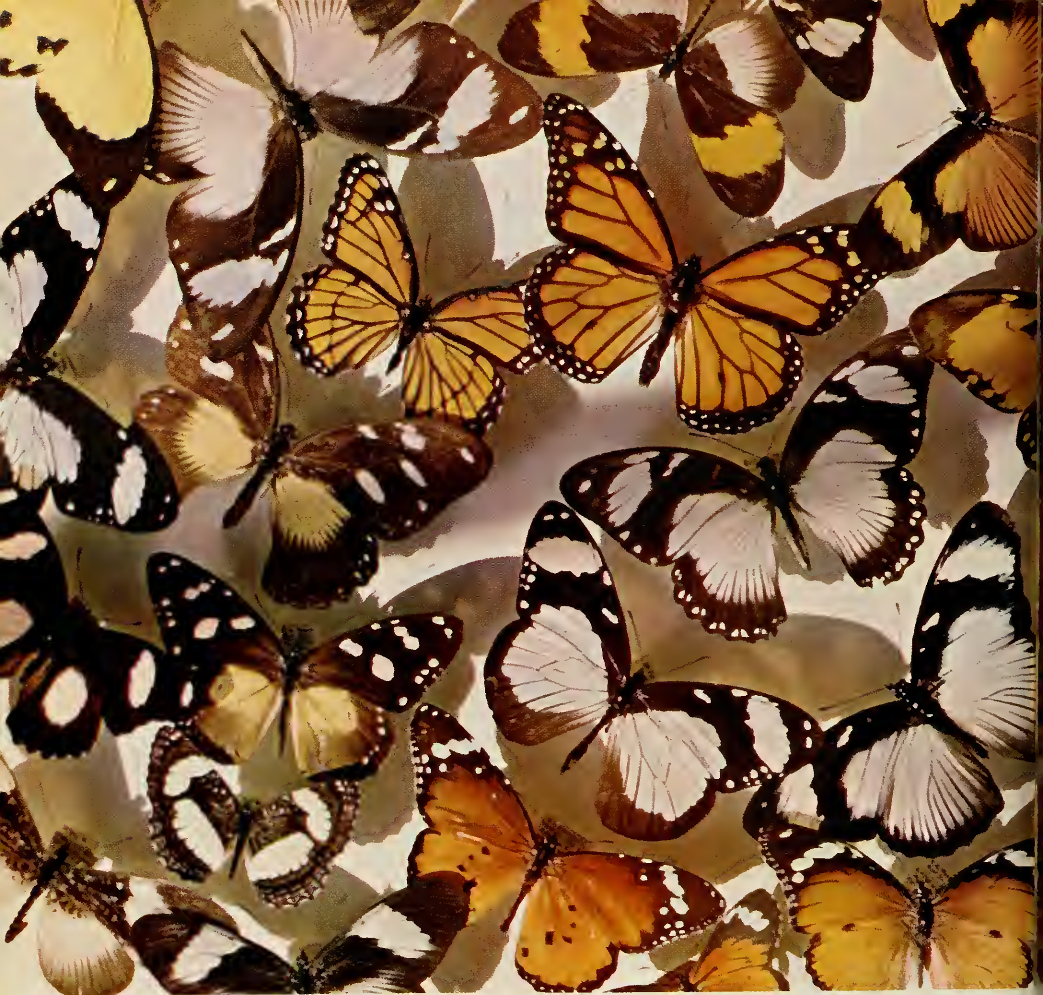
Alfred Wallace first drew attention to the similarity in color scheme common to many unrelated, but well-protected, animals, and propounded the theory of warning (aposematic) coloration. Subsequently, the great field naturalist Fritz Müller realized that if several such species associate together they improve their own chances of survival. Thus, birds quickly learn to generalize and will avoid the whole complex of somewhat similar, gaudy species after attacking only one or two examples. Noxious insects that have evolved such a general resemblance to one another are therefore known as Müllerian mimics.

While voyaging along the Amazon Valley, another of the great naturalists, H. W. Bates, observed that mingling with the flights of well-protected, warningly colored orange or black heliconid butterflies were a few specimens of an unrelated pierid butterfly, which had evolved a remarkable, but entirely superficial, resemblance to the heliconids. Bates deduced correctly that by developing this visual resemblance to the highly protected model, this "sheep in wolf's clothing" escaped predation by thus associating with a crowd of distasteful specimens. This type of mimicry, by which a harmless edible species is protected by the deservedly bad reputation of its model, is called Batesian, after its discoverer.

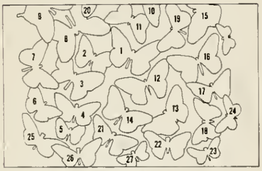
These categories are extremely useful, but arbitrary; in nature they merge into one another. Animals that have adopted the warning way of life generally have more than one line of defense, for they have varied enemies to contend with, and their classification as Müllerian or Batesian mimics depends to some extent on the reactions of the predators concerned and on the choice and abundance of available food.

For example, we have found that certain inexperienced birds reject both male honeybees (drones) and their mimic, the drone fly (*Eristalis tenax*), after only tasting them, and since both are refused after the initial experience (whichever is eaten first), they should clearly be designated as Müllerian mimics. On the other hand, Drs. Jane and Lincoln Brower (who have done more than anyone else to prove that mimicry actually works in the laboratory)

The buff tip moth rolls its wing around its body and resembles twig broken at both ends. This moth is also distasteful to many predator and is thus doubly protected

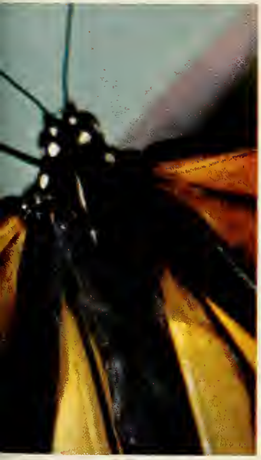


This group of mainly African butterflies contains examples of Müllerian and Batesian mimics, polymorphic females and non-mimetic males, and "pairs" in which the mimic is distinctly smaller than the model as in the monarch (1) and the viceroy (2).



1. *Danaus plexippus* (model)
2. *Limenitis archippus* (Batesian mimic)
3. *Papilio dardanus ceneus*
   (Batesian mimic, polymorphic female)
4. *Amauris albimaculata magnimacula* (model)
5. *Neptis agatha* (Müllerian mimic)
6. *Hypolimnas misippus* (non-mimetic male)
7. *Amauris niavius niavius* (model)
8. *Papilio dardanus hippocoon*
   (Batesian mimic, polymorphic female)
9. *Papilio dardanus dardanus* (non-mimetic male)
10. *Papilio dardanus trophonius*
    (Batesian mimic, polymorphic female)
11. *Bematistes tellus eumelis* (Müllerian mimic)
12. *Papilio dardanus hippocoonoides*
    (Batesian mimic, polymorphic female)
13. *Hypolimnas dubius wahlbergi* (Batesian mimic)
14. *Amauris niavius dominicanus* (model)
15. *Papilio dardanus niobe*
    (Batesian mimic, polymorphic female)
16. *Papilio dardanus dorippoides*
    (Batesian mimic, polymorphic female)
17. *Danaus chrysippus dorippus* (model)
18. *Hypolimnas misippus* form *inaria*
    (Batesian mimic, female)
19. *Bematistes poggei* (Müllerian mimic)
20. *Papilio dardanus tibullus* form *planemoides*
    (Batesian mimic, polymorphic female)
21. *Danaus chrysippus aegyptius* (model)
22. *Hypolimnas misippus* (mimetic female)
23. *Acraea encedon* (Müllerian mimic)
24. *Acraea encedon daira* (Müllerian mimic, female)
25. *Bematistes umbra hemileuca* (Müllerian mimic)
26. *Pseudacraea euryta tirikensis* (Batesian mimic)
27. *Mimacraea marshalli* (Batesian mimic)
28. *Mimacraea dohertyi* (Batesian mimic)

Yellow blood oozing from the defensive glands of the Jersey tiger moth. The white spots on the thorax of the monarch butterfly, far right, serve as a warning pattern and as faked bleeding points. The monarch contains heart poisons in its blood.

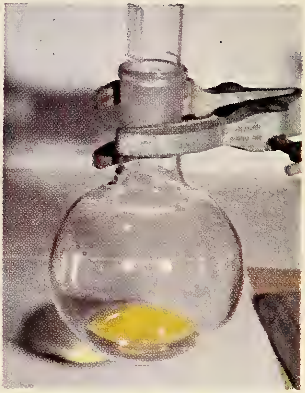


showed that toads readily ate drone flies until they had been stung by bees, but thereafter avoided both. At any rate, vis-à-vis the toads then, the drone flies are Batesian mimics.

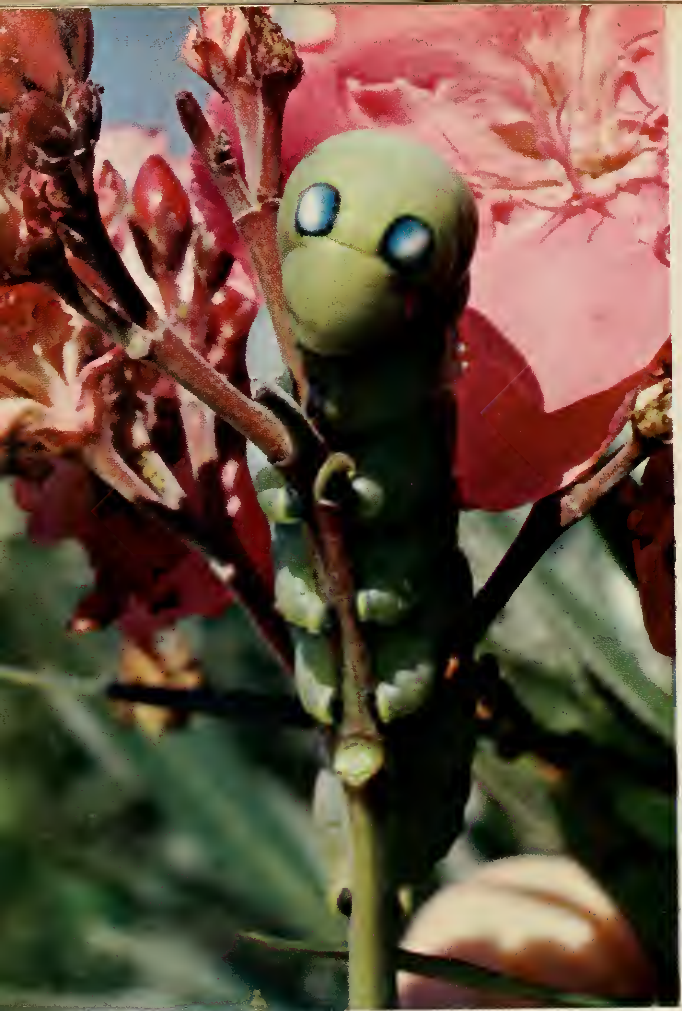
Birds and monkeys may also differ in their reactions to the same prey. A highly distasteful butterfly that serves as a model for many different mimics is *Danaus chrysippus.* This is one of the commonest butterflies in the Old World, a close relation of the monarch butterfly, and like it protected by the presence in its body tissues of heart poisons (cardenolides). These are obtained by the caterpillars directly from food plants of the milkweed family (Asclepiadaceae) and persist in the chrysalis and adult. A well-known effect of this poison is to induce vomiting in various vertebrates. One of the great English naturalists working in Africa at the turn of the century, C. F. H. Swynnerton, demonstrated that certain birds that ate *Danaus chrysippus* vomited violently 5 to 10 minutes after swallowing it. However, the marvelous mimic of this species, *Hypolimnas misippus,* was eaten with relish and no disagreeable aftereffects were observed. The same two species were offered to Professor Hale Carpenter's tame monkeys (*Cercopithecus* sp.) who would have none of them and rejected both with every sign of disgust after tasting them. Here, again, the classification depends on the reactions of the predators rather than a fundamental difference between the two types of mimics.

It should be noted, however, that a baboon ate the male *Hypolimnas,* which looks entirely different from the female and is not a mimic, with evident pleasure. This draws attention to a situation that has always presented something of a puzzle: why are the females of certain species Batesian mimics, while the males are non-mimetic? None of the theories put forward are entirely satisfactory, and here is a clue that might throw some light on the problem. It is possible that all warningly colored mimics start on this particular line of evolution by being slightly distasteful. This would help in establishing any mutation that might occur in the direction of resemblance to a model in either shape or color. Such an insect would be, in this sense, preadapted to mimicry. Are females preadapted in that they are more distasteful than males? I believe this is very probable; the literature is full of suggestive observations. Thus it is known that the female of the warningly colored garden tiger moth (*Arctia caia*) contains a lethal protein in its abdomen and eggs, totally lacking in the male; the female goldtail moth (*Porthesia chrysorrhoea*), also warningly colored and distasteful, contains seven to eight times more histamine in the body tissues than the male. It should be a simple matter to test the relative palatability of male and female Lepidoptera, and this offers a piece of research with considerable possibilities for the field naturalist.

It was originally remarked by Bates—and subsequently confirmed by other observers—that the more edible mimics are less numerous than their models. A little reflection shows that the mimicry situation often demands that this should be so. The protection of the mimic depends on how effectively the predators learn distaste and fear of the model. It is important that they should have as little experience as possible of the edible mimic, otherwise their learning process would be retarded or arrested. Consequently, the mimic is safest when it is present in substantially fewer numbers than the model, yet if its numbers fall too low, it is in danger of extermination in bad sea-



A flask containing the yellow blood of the warningly colored cinnabar, a very distasteful British moth.



The caterpillar of the oleander hawk moth is a versatile mimic; which at different periods can resemble many parts of the oleander bush. If disturbed it jerks its hidden eyespots into view, which scares off the predator.

Resemblance of pills to candies is a frightening example of man-made mimicry. Certain dangerous pills in this mixed group are even sugar-coated.

sons or "crash" years. There is, as Hugh Cott pointed out in his classic book on animal coloration, "an optimum proportion between the numbers of model and mimic and this limits the spread of the latter." But this optimum varies according to the quality of the learning ability of different predators and the degree of distastefulness of the model and other factors. Although, broadly speaking, the inedible model must be common and the edible mimic relatively rare in order to preserve the mimicry situation, this need not always be so.

In the case of warningly colored insects in general (and this of course includes Müllerian mimics) the presence of adequate numbers of alternative prey is an absolute necessity if this life style is to be successful. Yet another notable British field naturalist, Sir Guy Marshall, was the first to realize this. He pointed out that in Africa such butterfly mimics were rare in the dry season, when insects were relatively scarce and birds were very short of this type of prey, but common in the wet season, when butterflies swarmed in great numbers. In Britain, where insects are never as numerous as in the tropics, it is remarkable how the warningly colored species, particularly the Lepidoptera, are on the wing only during a brief period i midsummer. This interesting question of emergence dates has not, t my knowledge, been carefully studied. It would seem probable that i areas where insect life is not particularly rich the most distasteful o harmful of the Müllerian mimic would emerge first. The Brower have shown that the more disagreeable the model, the sooner the bir learns its lesson and the longer i remembers it. In Britain the mos distasteful warningly colored mot we have so far tested is the cinnabar (*Hypocrita jacobaeae*), and thi is on the wing well ahead of othe similar, brightly colored Lepidoptera. We have also found that bird unlike mice and spiders, have relatively long memories, and a lesso learned in May would certainly b remembered during the rest of th summer. A somewhat later eme gence date than that of the mod could also be expected for Batesia mimics, which could then afford be more numerous than otherwise—the lesson having been learned before they emerged.

Once embarked on the deceitful way of life, the Batesian mimics and the feebly distasteful Müllerian mimics must resort to further refinements in order to avoid their numbers falling to dangerously low levels. In this sense, as we have already pointed out, they are always between the devil and the deep. Certain Batesian mimics have, accordingly, resorted to polymorphism. They have evolved several female forms of the same species, each of which imitates different distasteful butterflies, thereby increasing their numbers as a whole while remaining scarce relative to their models. Thus the mimicry situation is preserved. Perhaps they can also afford to increase their numbers if their over-all size is reduced or was originally below that of their models. Swynnerton and Morton Jones both realized that in many situations wild birds have a marked preference for he largest insect available. We have found that hand-reared captive birds, which have had no experience of the insects in question, invariably elected the largest of two species offered. This often resulted in a ridiculous situation in which a chickadee struggled to eat a hawk moth arger than itself, instead of a species f manageable proportions. This predilection for sheer size on the part of bird predators should result n the really "good" Batesian mimic ncreasing its numbers by sheltering, o to speak, under the larger wing of he model. An inexperienced bird ould have a go at the largest insect resent and would thus learn its leson. A development of this sort ould be most likely to occur if the odel and mimic are a fairly isoted pair, such as the monarch *Danaus plexippus*) and the viceroy *Limenitis archippus*), and where e situation is not greatly compliated by the presence of swarms of üllerian mimics of varying derees of interresemblance. As far as know, no one has yet made a carel comparison of the relative size of odels and mimics, and this appears be another line of investigation ide open to the field naturalist.

One of the unsolved puzzles of warning color and mimicry is the means by which a bird comes to associate unpleasant aftereffects with a particular insect prey. It is obviously easy to associate a bright color with a vile taste as both can impinge on the senses simultaneously, but if a bird makes a meal of several butterflies, how does it know which one produced the vomiting or disagreeable sensations that follow? If insects such as *Danaus chrysippus* contain cardenolides, the vomiting is rapid and occurs soon after the meal, but this is not always the case. I once fed a tame, inexperienced crow a lot of brown noctuid moths and one specimen of the brilliantly colored garden tiger moth for its tea and again for its supper—all of which it ate. But by breakfast time the following morning it had developed a violent and, as it proved later, a permanent aversion to garden tiger moths, yet all the other dull brown species that were included in the meal remained in favor. Presumably it had suffered some form of disagreeable sensation an appreciable time after these two repasts, but by what means could it associate this with the real culprit? This seems mysterious and one can only surmise and speculate. In certain birds one may possibly find an inherited sensitivity to the color red. I suspect this could be true for the crow family. The morning-after-the-night-before possibly the only object that was imprinted clearly on the crow's mind, apart from its pain or discomfort, was the red moth. As a step in the right direction it should be relatively simple to devise an experiment to show whether the crow family learn to reject, for instance, mealworms "doctored" with quinine and dyed red (aposematic coloring) more readily than such doctored mealworms dyed blue or green. Nor should it prove too difficult to doctor mealworms with tasteless cardenolides, or any other substance with delayed aftereffects, and check if their color scheme enabled the bird to identify them subsequently, out of a handful of normal mealworms fed to it simultaneously.

It is quite probable that the powerful and peculiar smell of the defensive secretions of many aposematic species (which often ooze out if the insect is alarmed) has special memory-fixing qualities. It is noticeable that these scents have a peculiar evocative element, even for the human observer, and people search their memories and rack their brains to recall where they smelled this particular smell before. It has also been remarked that, just as many distasteful insects share a similar color scheme, so various warningly colored species share a similar smell; in fact there is Müllerian mimicry in scent as well as in color and pattern. Possibly the smell of these defensive secretions has a somewhat different effect on the predators than has hitherto been suspected. Once or twice while hand-feeding large numbers of the monarch butterfly—a long and somewhat laborious chore—I have been overwhelmed by the strange experience of *déjà vu*. This is the fleeting but unmistakable sensation "that everything has happened before," and the person experiencing this effect seems able to anticipate what is about to occur in the next few moments. It is now known that the phenomenon of *déjà vu* commonly occurs as a result of a local discharge in a portion of the brain known as the hippocampus and can be reproduced by artificially stimulating this area.

The first occasion on which this happened to me while feeding butterflies was completely forgotten until it suddenly recurred about two years later, when I was again handling large numbers of this species alive. This time the memory of the previous occasion, on which monarch butterflies were also the center of the episode, came flooding back, each detail more vivid than the last. The effect was startling. I did not know then, as I know now, that the monarch butterfly contains cardenolides (heart poisons) in its body tissues and its blood. The medical literature abounds with accounts of the hallucinations and weird mental aberrations produced in certain individuals by swallowing similar substances, such as digitalis. An exciting idea has since occurred to me, namely that the episodes described above were possibly not mere coincidences, and that inhaling some substance emanating directly from the butterflies initiated the *déjà vu* phenomenon. If this is so—and it is by no means impossible—the insect possesses an incomparable *aide mémoire* as one of its defense mechanisms. There is a great opportunity here for looking more closely at the insects feeding on plants that produce hallucinogenic compounds—such as *Cannabis sativa* (marijuana) and the Mexican peyote cactus (mescaline).

One of the great fascinations of mimicry is that it demonstrates the fantastic details of specializations. No doubt all animals are equally specialized. but the refinements are not so obvious in most cases. The buff tip moth (*Phalera bucephala*) is a superlative mimic of broken twigs. Since it rests on the ground beneath trees, it has developed "broken ends" at both extremities instead of one, and it rolls its wings round its body to simulate the roundness of a twig. The buff tip appears to be an example par excellence of the cryptic way of life. Yet oddly enough the species, as shown by Professor Poulton—and confirmed by me, because I could hardly believe this published record and had to see for myself—is a fairly distasteful insect. In fact, as a caterpillar it is clearly aposematic, and a possible explanation is that its distastefulness in the adult is a sort of automatic "carryover" from the larval stages. It is more likely that these qualities have been developed as a protection against bats, since both animals are nocturnal and on the wing together, and its cryptic appearance and habits protect it more effectively against diurnal predators such as birds. The spinach moth (*Lygris mellinata*), a small, highly cryptic geometrid, beautifully concealed when at rest by its resemblance to yellowing leaves, is also, so we found, extremely distasteful to bats. This species (and its relations) all have well-developed timbal organs (sound-receiving and sound-producing mechanisms), and it would come as no surprise to find that on the wing they emit supersonic clicks or pulses—as do certain noctuid moths—to warn bats of their disagreeable qualities.

To appreciate fully the specializations of mimics it is useless to confine one's attention to dried specimens; the insects, and if possible their predators, have to be studied in the field. The oleander hawk moth (*Daphnis nerii*) is a good example of these refinements. In the Mediterranean region the oleander bush on which this caterpillar feeds is heavily attacked by a bright yellow aphid. These three—the plant, the aphid, and the moth—must have traveled down the ages together. The aphids mass on the youngest shoots of the bush and, as they grow, the insects always move upward onto the newest growth, leaving their cast skins, like a shower of little white lumps, on the recently vacated leaves. The caterpillar has evolved a color scheme and behavior pattern that exactly fits in with this arrangement. Its body is the same green as the leaves and stems, it has a bright-yellow, tubercle-like "horn" on the posterior end of the body, which is the identical yellow of the aphids, and along the sides are a sprinkling of white dots, which resemble the aphids' cast skins. Furthermore, it can elongate the first segments and its head region until the anterior end of the body appears like a tapered oleander twig. Quite often, as it sits motionless on a young shoot, the aphids crawl onto its body. The caterpillar may then be seen snapping at the aphids, much as a dog would snap at flies, and this tends to keep them toward the end of the body where the yellow horn—looking very like another large aphid—is situated. Their camouflage is so superlative that although their presence on a given bush is known for certain, it is often impossible to find them while they are resting. If by chance, however, one of these motionless caterpillars is tapped, the head is instantly tucked in and the anterior end arched, suddenly exposing two enormous blue-and-black eyespots, which are normally concealed beneath the flesh of an overlapping segment. The dramatic suddenness with which the "twig" is transformed into a "something" with glaring eyes must effectively startle and scare off small birds and similar predators. These caterpillars pupate underground, and before leaving the oleanders they change color to match the earth beneath the bush. During the transition from green to brown they become a dirty-pinkish color, tinged with yellowish green, and hide among the faded pink petals of overblown oleander flowers—at this period they nibble the flowers as well as leaves. By the time they are ready for their hazardous digging operations, they have changed to dark brown and exactly match the soil. Beneath the bushes, where the digging takes place, the ground is generally sprinkled with single, squarish, drum-shaped pellets of frass, dropped previously by the caterpillars while feeding. At this stage the caterpillar's eyespots are no longer concealed and have changed in outline and color so that they resemble two pieces of its own droppings!

A not dissimilar type of specialization is found in warningly colored species with markings that simulate their own defense mechanisms. Many poisonous insects have specialized bleeding points, often via the opening of a gland that secretes a defensive fluid, through which they ooze or forcibly eject their own blood mixed with toxic secretions. It is clearly no coincidence that the blood of many aposematic insects is

The lappet moth is an otherwise unprotected insect frequently mistaken for a leaf and thereby overlooked.

yellow and must form part of the general scheme of warning coloration. The drops of defensive fluid often take the form of bright-yellow droplets and bubbles. However, once these defensive glands have ejected their contents it takes some time for them to be replenished; consequently, various species have developed marks that simulate these drops of yellow blood, so that even if the secretion is exhausted—or for that matter before it is actually exuded—it still appears to be present. Two such spots can be seen, for nstance, on the thorax of the scarlet iger moth (*Panaxia dominula*). An African butterfly, *Acraea insignis* (and various other members of this genus), has well-marked bleeding points at the tip of the antenna and round the mouth, and in this species both the maxillary palps and also the ends of the antennae are colored bright yellow. Another insect in which this type of specialization is ound is *Phymateus viridipes*, a rasshopper that exudes a poisonous efensive froth along the sides of the thorax. The integument in this area is raised into various irregular bumps and little lumps that catch the ght, giving the impression that the foam is more extensive than it is or that it is permanently present. I doubt if anyone has hitherto examined the blood of Batesian mimics to see whether it is also yellow. Nor do I know if any true Batesian mimics are perfected to the point of producing faked bleeding points. But these are details that can easily be checked in the field.

So fantastic are the specializations and refinements in the field of warning coloration and mimicry that it is easy to allow one's imagination to run riot. It is as well not to be carried away! If an ardent naturalist from some other world descended on our planet today, well versed, of course, in the current theories of mimicry and evolution, he would certainly be nonplussed by the extraordinary resemblance between dangerous pills and children's candies. At first sight the situation might not seem so complicated. The pills, such as the bright-yellow Nembutol capsule and the orange Seconal are clearly the models—a few experiments would reveal that they are in fact very toxic. The candies, British Spangles, Licorice Comfits, Smarties, and Glees are, on the other hand, extremely successful Batesian mimics. Certain examples such as the green, bomb-shaped Pantozyme (a Swiss product for the relief of flatulence), the brown Codoform Botol (an international remedy for irritating coughs), or the orange, spherical Tofranil would fit in quite nicely as swarms of less well-perfected Müllerian mimics. A few might prove a trifle difficult to classify, especially the more lethal pills deceptively coated with sugar! But when the Martian naturalist tried to explain the phenomenon in terms of natural selection, he would probably find the situation extremely confusing. Eventually he might well have to be satisfied with the notion that this was an example of an animal with a built-in mechanism for the regulation of its own members.

It is a sobering thought that even today there are some first-rate biologists who are not convinced that mimicry exists at all, except in our imaginations. They are willing to concede that animals have, in the course of evolution, come to resemble inanimate objects, such as a dead twig or a bird dropping, but they believe there is no proof that the resemblance between one animal and another is due to any cause other than shared environmental effects and parallel evolution. That such doubts still linger in some minds—although I do not subscribe to them myself—may add to the attraction of mimicry as a field for investigation.

Unraveling the Age of Earth and Man

By E. L. Simon

Rocks contain not only fossils but radioactive elements that supply increasingly precise dates for important portions of the geologic time scale

For thousands of years man has sked and tried to answer a dual uestion—how old is the earth and ow long is it since the appearance of rimates and the emergence of mod- rn man? The answers have often een as interesting—and far ranging as the riddle itself. It was not until bout thirty years ago, however, that searchers began offering reason- bly satisfactory figures. And it is nly since the late 1950's that an undance of precise dates have be- me available to chronologists who al with the prehistoric past.

Previously, of course, there had en no lack of estimates. They oc- r, for example, in the sacred books many religions. In India the Brah- ns considered earth and time as rnal, while some Hindu chronol- ies indicate that thirteen million rs had passed since their "golden e" began. Manetho, the Egyptian torian, listed dynasties of gods d demigods estimated to have gned on earth for some thirty-six usand years—from the first dy- ty of the gods to the thirteenth torical dynasty. Hebrew priestly ters provided a chronology dating ation at about 4000 B.C., and they m to have based their creation y, in part, on earlier Babylonian hs, some of which implied an n greater time since creation.

mong many Christians it was ight that the Bible narrative and chronology could be taken liter- ; and in 1654 Archbishop Ussher Armagh, Ireland, seemed to find ncertainties in the Bible record n he calculated from biblical alogies that the earth had been ted in 4004 B.C. In fact, one of Ussher's contemporaries determined the precise time—the twenty-third day of October at nine o'clock in the morning. Jewish scholars, however, studying the same Old Testament sources, dated the world's creation as October 7, 3761 B.C.; with this date the Jewish calendar begins.

Many modern theologians have challenged, sometimes ridiculed, such literal interpretation of scriptural sources. More than fifteen hundred years ago, St. Augustine proposed that the six days of creation might signify only a logical rather than real succession, and at present even conservative Christian scholars usually agree that one can interpret the six days of creation as standing for six general periods, or eras, rather than for specific 24-hour periods. Meanwhile, with the growth of scientific knowledge in the eighteenth and nineteenth centuries, it became increasingly clear to scholars that the earth must be much more than a few thousand years old. A number of ingenious procedures for estimating the age of the earth, of life, or of the oceans were attempted. All these, however, involved relative methods—no broadly applicable "absolute" or "chronometric" ways of dating rocks were yet known. In 1715, for instance, when the astronomer Halley proposed the first scientific procedure for determining an approximate age for the earth, he assumed that if on initial condensation the primal oceans were fresh water, one could calculate their age by dividing the total amount of sodium salts already present in the oceans by the average amount that is added to the oceans each year from the rivers of the world. Later scientists elaborated this approach, but produced estimates that were too small. We know now that accurate determination of the amount of sodium that land erosion adds each year is uncertain, that the amount added per annum has fluctuated greatly and was probably unusually high during the Cenozoic Era. We also know that salt is removed in deep-sea sediments and as salt deposits produced by evaporation in large inland bays. If the addition of salt had always proceeded at the present rate of about 400 million tons of salt yearly, then one would have to conclude that the seas are only about 100 million years old; the uncertainties are such that this can only be a minimum estimate.

Another early procedure for estimating the earth's age involved measuring the world annual rate of deposition of sediment, which is brought about by the agents of erosion—principally wind and water—and dividing this into the total estimated thickness of sediments. For if geologists can estimate the average rate at which sedimentation occurs, they can then determine how long it has been depositing the measurable thickness of geologic layers.

In 1799 William Smith, an English canal surveyor, announced one of the basic concepts upon which the science of geology depends. He pointed out that each rock formation he had observed contained fossils peculiar to itself, and that the fossils present in each formation "always succeed one another in the same order." Fossils thus became the chief instrument for quickly identifying the relative age and sequence of each rock layer. Since the day of William Smith, geologists have separated the series of rock layers into six main divisions or eras: the Azoic (without life), Archeozoic (beginning life), Proterozoic (early life), Paleozoic (ancient life), Mesozoic (middle life), and Cenozoic (recent life, including development of mammals).

Adding up the total known thickness of rocks deposited during the Cenozoic, Mesozoic, and Paleozoic Eras, Professor James D. Dana of Yale was able, as early as 1876, to calculate that the relative durations of these eras were in the ratio of 1:3:12. But not having an accurate estimate of the average rate of sediment deposition throughout geologic time, he was unable to successfully convert these ratios to numerical values. Moreover, parts of the sedimentary sequence, called the "stratigraphic column," were missing.

The divisions between geologic periods come where early geologists observed great unconformities. An unconformity is a gap between two layers of rock, usually caused by a period of widespread erosion during which all the strata that would have filled the gap have been destroyed.

One can easily see that when layers of shale, sandstone, and limestone are laid down on one another, like layers in a cake, those on the lowest levels are older than those above them. But sometimes these relatively flat layers become folded in the processes of mountain-building, and the crests of such folds may eventually be eroded away, leaving a series of worn edges upon which new flat-lying layers may be deposited. Consequently, between the old, folded layer and the newer one immediately above it, the time required to build and erode the mountain is represented only by a surface, seen in cross section as merely a discontinuity. Such a surface is an unconformity, and such gaps make the geologic record seem like a book from which pages have been torn at intervals. So far, it has been impossible to discover all these missing pages in existing deposits. And in the early days of geology there was no way of estimating the lapse of time corresponding to these great unconformities other than by noting the relative amount of difference or the extent of evolution between the fossils above and below the gap.

Within these limitations, by measuring the greatest thickness of each rock layer and adding up the results, one finds that during the Paleozoic, Mesozoic, and Cenozoic Eras, a total thickness of about 68½ miles would have accumulated if deposition had continued in one spot for the whole period of time. This estimate does not include the lapses of time during all unconformities; if one allows for them it would probably increase the total height to nearly 100 miles. One estimate of the average rate of sedimentary deposition is about one foot every 880 years, which would indicate that the last three geologic eras have lasted some 440 million years.

Accurate measurement of the older three eras is impossible because of frequent gaps in our knowledge of sedimentary deposition, but it is thought that they probably lasted over three times as long, or about one and a half billion years.

Despite their ingenuity, the sedimentary methods of dating the age of the earth or the oceans were never too accurate. Their inadequacies were carefully analyzed in 1917 in an important review of "Rhythms and the Measurement of Geologic Time," by Joseph Barrell. Among other things, he pointed out that estimates of time lapse from sediments are uncertain because erosional rates have fluctuated in the past, and the thickest sediments usually accumulate in narrow marine troughs that contain little of the total product of nearby continental erosion.

By the nineteenth century, a number of geologists had taken another tack. They were estimating the length of time since the development of earliest life. In 1867 one of the founders of the science of geology, Sir Charles Lyell, conjectured that 240 million years might account for the successional changes in animal and plant species. But a contemporary estimated only 60 million years for the same span (since the Cambrian Period). The smaller figure led Charles Darwin to write that it could hardly account for the total development and evolution of organisms. At about the same time, however, an even younger age for the earth was proposed by the physicist Lord Kelvin. His estimate came from determining the rate of cooling of the planet from a state of completely molten rock to its present composition, with only a molten core. In a series of papers, he decreased his first estimate of 400 million to only 20 million years. Obviously, this latter figure greatly distressed most contemporary geologists and paleontologists—it did not allow enough time for known changes that had taken place, particularly in earth's fauna. Kelvin, however, had not taken into account an extra source of heat—unknown to him—that would keep the earth warm for a much longer period: the heat produced by radioactivity. Moreover, there is growing agreement among investigators that the earth did not originate as a molten body. More likely, the earth, as well as the other planets, was accumulated through the gradual accretion of smaller bodies and subsequently warmed by heat from radioactive decay.

It may be difficult for today's reader to realize the impact of those various estimates—not only upon others but also upon such scientists as Darwin, Lyell, and Kelvin themselves. They were forced to readjust their thinking from the widespread Christian assumption of a 6,000-year-old world to one that could be several tens of millions of years old. When figures reach such an astronomical scale, it does not require a grand readjustment in thinking to conceive of the world's age as 200 million or even several billion years. Moreover, grasping the meaning of such vast amounts of time is beyond the capacity of most of us. Probably as a consequence of this challenge, twentieth-century geochronologists appear to have been more interested in the accuracy of their calculations than in their antiquity.

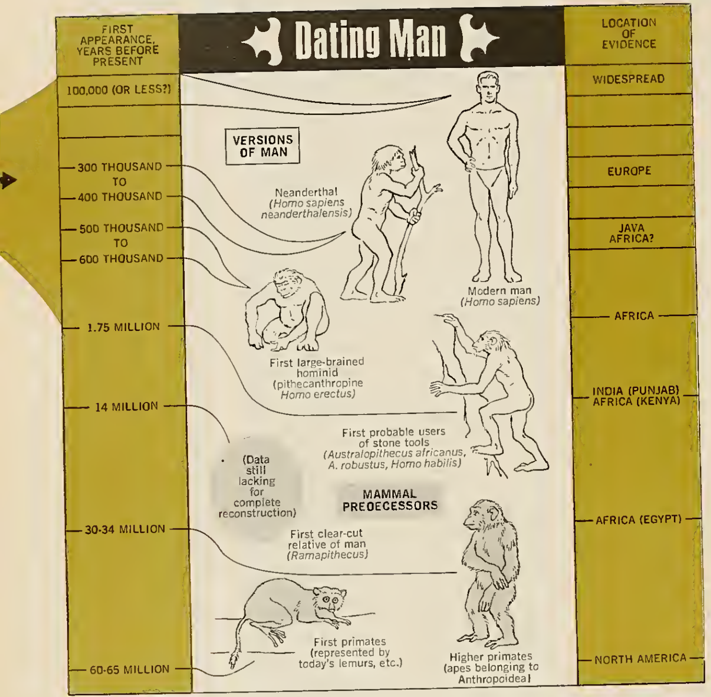
Methods depending on radioactive processes have been by far the most fruitful and accurate for determining the age of the earth. Only a few of the more informative of these methods can be briefly summarized here, nor does space allow much detailing of the many intricate processes and complex considerations by which geochemists and geophysicists now date rocks. Generally speaking, progress in the past five o ten years has made it possible to obtain accurate dates for the formatio of many of the main types of rocks

The origins of geochemical datin go back to 1905, when Bertram Boltwood pointed out the universal presence of lead in uranium-bearin rocks and observed that the ratio between lead and uranium was ofte more or less uniform for uraniu minerals from the same region. H also expressed his belief that thi must indicate lead of some kind i the end product of the spontaneou breakdown of the radioactive element uranium. Later he propose that if lead was a product of thi process of decay, the ratio of lead t uranium should be the same for mi erals of equal age. Consequently, i in a given sample we learn both th amount of radioactivity-produce lead and the amount of still-u changed uranium, the age of th rock can be determined by the rel tive proportions—if we know the ra at which the uranium disintegrate

It happens that there are sever types of lead, each differing slight in atomic weight. Such varieties the same element are called isotope

Comparative Geologic Time Scale

ERA	PERIOD	EPOCH	DISTINCTIVE FEATURES	KULP (1961)	SYMPOSIUM (1964)
CENOZOIC	QUATERNARY	PLEISTOCENE	Early man; continental ice sheets	1	7
	TERTIARY	PLIOCENE	Large carnivores	13	1.5-2
		MIOCENE	First abundant grazing mammals	25	26
		OLIGOCENE	Large running mammals	36	37-38
		EOCENE	Many modern types of mammals	58	53-54
		PALEOCENE	Diversified hoofed mammals	63	65
MESOZOIC	CRETACEOUS	MAESTRICHTIAN	First primates (?)		
		UPPER	First placental mammals First flowering plants; climax of dinosaurs and ammonites, followed by extinction	110	
		LOWER		135	136
	JURASSIC	UPPER	First birds, first mammals; dinosaurs and ammonites abundant	166	
		MIDDLE LOWER		181	190-195
	TRIASSIC	UPPER	First dinosaurs. Abundant cycads and conifers	200	
		MIDDLE LOWER		(230)	225
PALEOZOIC	PERMIAN	UPPER MIDDLE	Extinction of many kinds of marine animals, including trilobites. Southern glaciation	260	
		LOWER		280	280
	CARBONIFEROUS: PENNSYLVANIAN		Great coal forests, conifers. First reptiles	320	
	CARBONIFEROUS: MISSISSIPPIAN		Sharks and amphibians abundant. Large and numerous scale trees and seed ferns	345	345
	DEVONIAN	UPPER	First amphibians and ammonites; fishes abundant	(365)	
		MIDDLE		390	395
		LOWER		405	
	SILURIAN		First terrestrial plants and animals	(425)	430- 440
	ORDOVICIAN	UPPER	First fishes; invertebrates dominant	445	
		MIDDLE LOWER		500	ca. 500
	CAMBRIAN	UPPER	First abundant record of marine life; trilobites dominant	530	
		MIDDLE LOWER		600 ?	570
	?		?		



The detailed chart of primate evolution, above, shows that even when man is defined as any hominid who makes stone tools, evidence dates his arrival at less than two million years ago. This explains why the complete geologic calendar on page 55 allows little space for late stages leading to modern man.

The isotopes of lead include: (1) primal lead, atomic weight 204—a lead believed originally formed as that element; (2) uranium lead, at. wt. 206—resulting from the breakdown of uranium's predominant isotope (U-238); (3) actinium lead, at. wt. 207—end product of a breakdown sequence beginning with another uranium isotope (U-235): (4) thorium lead, at. wt. 208—from the breakdown of thorium (Th-232). The rate for uranium is so slow that it takes over four and a half billion (4.51×10^9) years for half of the atoms in a starting amount of it to disintegrate. This figure is the "half-life" of uranium. It would take even longer, 13.9×10^9 years, for half of thorium's atoms to "decay."

But a timing method should be accurate. How can science be so sure that the disintegration of uranium and other radioactive elements has continued at the same rate throughout geologic time? Here is how the rocks themselves indicate that the rates of decay have remained unaltered. Dark mica, or biotite, acts as a sort of photographic plate for the alpha particles released during the radioactive breakdown. If a microscopic particle of uranium is trapped in a piece of this mica, examination under polarized light will show small darkened rings around the central particle. Such microscopic rings form the so-called pleochroic halo and are known from rocks of all geologic ages. They are caused by the discharge of alpha particles, and the distance these particles will travel in the mica depends on the energy of atomic transformation. With uranium, the pleochroic halo will consist of eight separate rings. Very accurate measurements have shown that the energy of transformation, and therefore the rate of breakdown, is constant in all samples. In addition, numerous experiments have confirmed that the constant rate cannot be changed by an outside influence such as pressure or temperature. There is no danger of confusing primal lead (204), which might also be present in a radioactive sample with the products of atomic break down, because the leads of differen origin differ in atomic weight.

So far, the oldest rocks carefull dated (in North America) by th uranium method are Precambria ones in the Minnesota River Valle The Morton and Montevedes granit deposits in this valley contain zi cons indicating they were crysta lized at least 3,300 million years ag In some parts of the world, rock giving ages of the same order magnitude are intruded into or ove lay older rocks. It has not yet bee possible to date these older rock because they have been serious altered by more recent events. Po sibly they were more immediately d rived from the original crust of t earth, but geologists have not y found a rock that could qualify part of the earth's original crust.

However, some scientists belie that meteorites that contain lead m have the same age as the earth a the rest of our solar system. If then the age of the earth, as indicat by recently calculated uranium-le ages of meteorites, increases to proximately 4,500 million yea This figure can be considered wit the framework provided by ot probing for dates. For instance, cent studies based on radioact potassium indicate that about billion years ago such potassi began breaking down into an isot of calcium. Here may be a clue to age of our part of the universe.

Work with this potassium il trates the usefulness for earthly of radioactive materials other t uranium and thorium. Specific accurate determinations can be m on rock containing carbon, p sium, or rubidium. The two named, both members of the al metals family, are especially sig cant. In the past seven to nine y improvement in dating geol events has come through analys the radioactive decay of potass (at. wt. 40) to argon 40, and ru um (at. wt. 87) to strontium 87.

These two geochronometric methods have widely expanded the dating ossibilities because radioactive po- assium and rubidium occur in many nore rock types than datable ura- ium and thorium. (And uranium lates can be used as a countercheck n potassium or rubidium dates if wo or more analytical methods can e run on the same rock.) Potassium- -argon dates are particularly use- ul to paleontology because they may e determined from rocks often ound associated with fossils, such as lauconites (greensands), ash falls, nd lava flows. The principle under- ing determination of potassium/ rgon and rubidium/strontium ages f rocks is basically the same as that f the uranium/lead and thorium/ ad dating methods, but the labora- ry procedures for analyzing the ry small traces of these isotopes e considerably more complex.

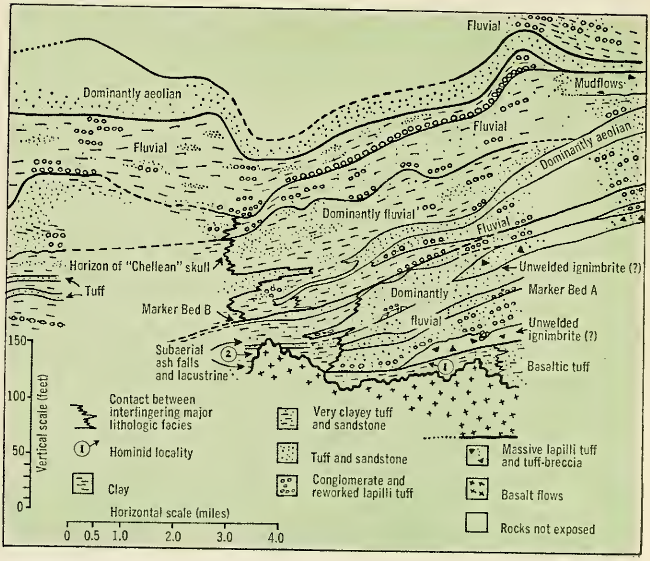
Combining all these various dat- g methods, a reasonably accurate ronology or geologic time scale is w available for the time during ich development of plant and ani- al life can be traced on earth from e Cambrian Period to the present. is is valuable because, although ces of simple life—perhaps resi- es of single-celled organisms— ve been found and dated back to ee billion years ago, the Cam- ian is the oldest geologic period in ich fossil organisms are abundant d can be traced in detail through ccessive evolutionary stages. From n on, the geologic calendar can dated with considerable accuracy. e chart on page 55 shows dating ne in 1961 by J. Laurence Kulp, inent American geochemist, and isions made by a Geological So- ty of London symposium in 1964.

Now let us apply the foregoing niques to a problem of general erest—to dating the main stages of lution in the order of Primates, axed by the arrival of modern . About six years ago, Dr. Ken- Oakley, noted anthropologist of British Museum, outlined an ap- ximate dating of some of these n steps, but so rapid has been recent advance of knowledge— only of dates, but of fossil pri- es as well—that another analysis as warranted.

Until recently, the earliest known primates were found in deposits of Middle Paleocene age in western North America, but in 1965, what is probably a primate tooth was reported from latest Mesozoic deposits in Montana. This means that documentation of the emergence of this mammalian order should be sought in the faunas contemporary with the last of the dinosaurs. The date of the close of the Mesozoic Era, when those earliest primates existed, is indicated by several geochemical dates. One was obtained from ash falls in Alberta deposits of the latest Cretaceous substage—on the order of 63 to 66 million years ago. A potassium/argon date, calculated by J. F. Evernden and his associates at the University of California, was derived from a basalt rock near Denver, Colorado. The basalt, which lies above shales or mudstones containing mammals typical of the earliest kinds of Paleocene fauna, shows an age in excess of 58 million years. Consequently, primates apparently came into existence as a group between 60 and 65 million years ago.

The primate fossils so far obtained from rocks laid down many millions of years following that time all resemble the present-day lower primates, or prosimians—including the lemurs, lorises, and tarsiers. These were widespread in the Early Tertiary, particularly in the Northern Hemisphere. They are abundant in the Eocene rocks of western North America and Europe, and are beginning to turn up increasingly in China, in rocks of similar age. Members of the order Primates did not reach South America until the Oligocene Epoch. Although Eocene land mammals are unknown in Africa, it is probable that there were also early primates on that continent, as the ancestors of the Malagasy lemurs of today presumably reached Madagascar early in the Cenozoic Era by way of the African continent.

A second main stage in the evolution of primates was the development from prosimians of the higher primates, or Anthropoidea (apes and monkeys as well as men). Among the many common features of the Anthropoidea that might signal the appearance of this level of primate organization in the fossil record are the characteristic closure of the orbit behind the eye into an eye socket and the reduction of the number of premolar teeth from four to two on



Fluvial
Mudflows
Dominantly aeolian
Fluvial
Fluvial
Dominantly aeolian
Dominantly fluvial
Fluvial
Horizon of "Chellean" skull
Unwelded ignimbrite (?)
Tuff
Marker Bed A
Dominantly fluvial
Marker Bed B
Unwelded ignimbrite (?)
Subaerial ash falls and lacustrine
2
1
Basaltic tuff
150
100
50
0
Vertical scale (feet)
Contact between interfingering major lithologic facies
1 Hominid locality
Clay
Very clayey tuff and sandstone
Tuff and sandstone
Conglomerate and reworked lapilli tuff
Massive lapilli tuff and tuff-breccia
Basalt flows
Rocks not exposed
Horizontal scale (miles)
0
0.5
1.0
2.0
3.0
4.0

Stratigraphic evidence of the earliest true man comes from deposits in Bed I of Olduvai Gorge, East Africa. Radioisotopes have dated its tool users as living 1.75 million years ago. Depicted here is bed sequence prior to faulting of rock.

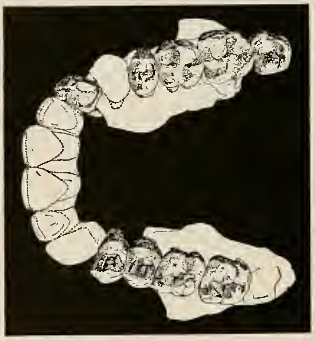
each side of each jaw. Both of these features are first observed in fossil "apes" from the Early Oligocene in the Qatrani formation of the Fayum province of Egypt. No geochemically datable rocks have been found in these Egyptian fossil fields, but they are overlain by a volcanic rock that may soon be dated. The animal fauna with which these ancient apes (*Propliopithecus*, *Aeolopithecus*, and *Aegyptopithecus*) were recovered indicate an earliest Oligocene land mammal age. In North America, Early Oligocene rocks are associated with Chadronian fauna, which Evernden, *et al.*, have dated by the potassium/argon method with ages ranging from 33 to 36 million years. By that time the higher primates had definitely differentiated in Africa, and perhaps elsewhere as well.

At least since Darwin's time, a great problem confronting evolutionists has been: How close are apes and men taxonomically, and when did their ancestry split? Although these questions remain partly unanswered, we can now determine the age of the oldest clear-cut relatives of man, as opposed to apes, from data concerning species of the Mio-Pliocene genus *Ramapithecus.*

This primate, like both modern and primitive man, had small canines and front teeth, a short face, an arched palate, and massive jaws with crowded teeth arranged in a semicircle, rather than in a U-shaped dental arcade with parallel cheek tooth rows. I have recently placed species of *Ramapithecus* in the taxonomic family of man: Hominidae. The oldest dated members of this genus come from near Fort Ternan, Kenya—from a deposit that the potassium/argon method has shown to be 14 million years old. How much prior to this date the families of man and apes separated is still unknown.

Much more is understood today about the time when modern man's forerunners first began to use stone tools. Paleoanthropologists have usually adopted the definition of man as any hominid that makes stone tools to a set and regular pattern. So defined, the earliest "men" are evidenced by living floors in Bed I of the now-celebrated Olduvai Gorge sequence of Early Pleistocene deposits in Tanzania, East Africa. The deposits of Bed I, in which stone tools first occur, have been dated by the University of California group at 1.75 million years. This figure sums up more than sixty separate potassium/argon analyses. Its accuracy therefore correlates with the accuracy of this dating method.

Admittedly, these oldest dated human cultural sites at Olduvai are not necessarily those of the first actual users of tools. But it can be assumed that tool using probably did not become general much earlier. If it had, archeologists would presumably be able to document this from sites of tool use and manufacture elsewhere in Africa (apart from East Africa) and in Eurasia as well. Controversy about the toolmakers at Olduvai has been stirred by the unsound taxonomic procedures that have been used to name them. Although the names *Zinjanthropus boisei* and *Homo habilis* have been proposed for them, there is no clear-cut evidence that hominids other than two species of *Australopithecus* —*A. africanus* and *A. robustus*— earlier named in South Africa, existed in Tanzania in Bed I times.



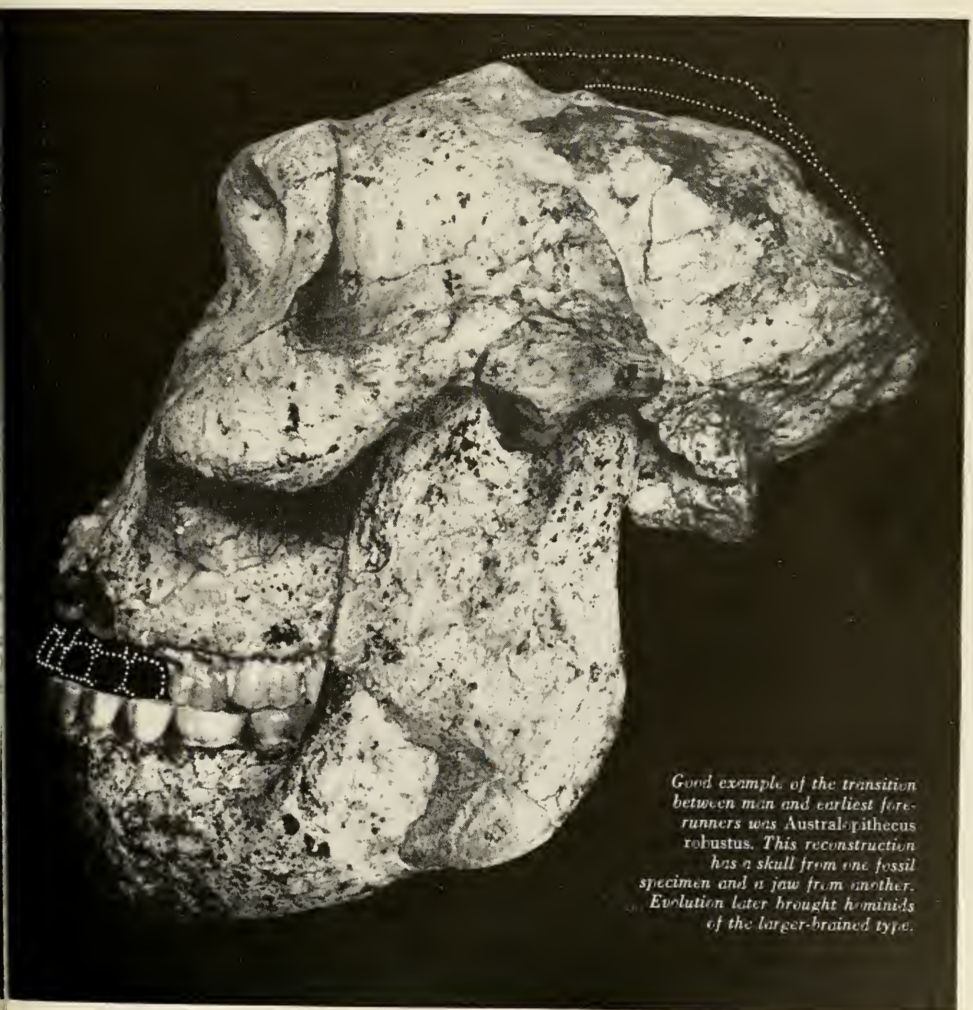
Prehuman Ramapithecus, *dated at 14 million years ago, was probably the first clear-cut relative of man. It had an arched palate and crowded teeth in a semicircular instead of U-shaped array.*

The next important stage in human evolution was signaled by the appearance of large-brained hominids of *Pithecanthropus* type—those with brain volumes of more than 700 cc., as opposed to the earlier *Australopithecus* brain volumes on the order of 400 to 600 cc. The first these pithecanthropines, from Ja was described in 1892 as *Pithec thropus erectus.* Investigators u ally now consider it to be a spec of *Homo—H. erectus.* The evoluti ary emergence of *H. erectus* appe to be documented also at Oldu but is not as precise or certain as wish because the rock samples fr this horizon do not have as suita a composition for potassium/ar (K/A) dating as do those from I. Drs. Curtis and Evernden h recently rechecked their K/A from sediments at the top of Be Olduvai and have determined approximate age of 500,000 ye Inasmuch as the Oldowan pithe thropines were all collected be this horizon, they must be older t half a million years—which co lates reasonably with the recent K determination of 0.6 million y on tektites from the Djetis bed Java, from which the earliest *erectus* come.

For the time period within w the completely modern *H. sap* type of men evolved, another chronometric method can be us radiocarbon dating. But because half-life of radioactive carbo only about 5,000 years, dates in cess of 40,000 or 50,000 years inaccurate. Also, the K/A da method is increasingly inaccurat dates of less than one million y Consequently, there is a period ing Early and Middle Pleisto times when dating human remai difficult and uncertain. During time, *H. erectus* populations pre ably graded into the Neande type of primitive man, a varie which most modern taxono would give only subspecific st *H. sapiens neanderthalensis.* N derthalers have been dated as sisting in western Europe for tw three hundred thousand years. seem to overlap with human f that appear to be more like tho modern man, of which the ones Fontechevade and La Ferassi France are examples. These probably represent only the progressive individuals and n different race. The more abun skeletal finds of Stone Age me about 30,000 to 40,000 years Many have been dated accurate the radiocarbon method and, c quently, the structural and cultural evolution of Late Paleolithic man is well documented and dated. Sufficient to say that within the period in which radiocarbon dating of fossil man is possible, only slight alterations in skeletal anatomy have occurred; as far as the main stages of locomotor adaptation and evolutionary change are concerned, man's ancestors of 40,000 years ago were essentially the same as man is today.

And what may the future reveal about our prehistoric calendar? As nore and more fossil-bearing sedinents are dated, multiple cross-checks on individual dates will be possible, and this should eventually lead to a nearly absolute chronology for life of the past. Nevertheless, some sediments will probably never be datable, because many lack sufficient concentrations of any of the known unstable isotopes of common elements. Even so, if such rocks contain traces of past organisms, they can be correlated in time with the same organisms in dated rocks.

Some scientists have suggested that when, and if, this geochronological "millennium" arrives there would be great value in rearranging or renaming the divisions of geologic time to correspond with fixed time durations. Thus the Tertiary, which lasted roughly sixty million years, could be divided into six subdivisions of ten million years each. Whatever the course adopted, it is clear that geochemical dating will eventually provide an accurate calendar for placement of fossil species in their proper temporal relationships. Until this is done, science cannot remain satisfied: uncertainties in interpreting the exact course of evolutionary history will remain among almost all groups of organisms.



Good example of the transition between man and earliest forerunners was Australopithecus robustus. *This reconstruction has a skull from one fossil specimen and a jaw from another. Evolution later brought hominids of the larger-brained type.*

Euglena and the Tides

These itinerant one-celled protozoans time their migrations with a precise clock mechanism

By JOHN D. PALMER

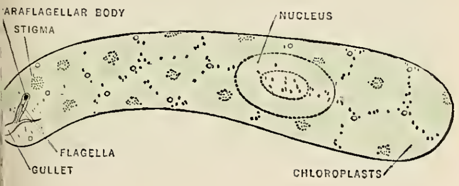
The great pyramids of Egypt are not only the tomb of a few godlike Pharaohs but also the final resting place of literally billions of fallen protozoans, fo the pyramids are built from stone composed of th compressed, chalky remains of fossilized Foraminifer —single-celled animals that antedate the entombe monarchs by millions of years. Similarly, the Avo River in England is not only the site of a present-da shrine to Shakespeare but also the past and prese residence of a great horde of another type of prot zoan, the chlorophyll-bearing unicell *Euglena obtus*

Few visitors to Stratford on Avon realize that at th point where the modest, somewhat stagnant, meande ing river flows into the Irish Sea, there is a tidal e change of water second in height only to the famo tides of the Bay of Fundy in Nova Scotia. Avon tid change, however, can be even more spectacular th its North American counterpart, for during dayti low tides, the initially black mud of the exposed rive bed takes on a dappled green appearance that grad ally becomes mottled with splotches of golden brow The verdant color is due to the presence of enormo numbers (more than a hundred thousand organis per square centimeter during the summer months) this chlorophyll-bearing *Euglena*. They are so abu dant that they form a living veneer of writhing cel piled one on top of the other, on the exposed ri mud. During high tide they burrow a few millimet into the mud and are thus prevented from bei washed away; during daytime low tides they move onto the surface of the exposed mud. These mo ments, into and out of the substratum, are repea with such beatlike regularity that this behavior called a vertical-migration rhythm.

When compared to the long-distance, north–so migrations of many birds, the short journeys of *Euglena* seem relatively unspectacular. Neverthel although these tiny cells move a total distance eq to only 20 times the length of their bodies, the chan they encounter in their travels are as rigorous as endured by migrating birds. They move from nearly complete darkness to full sunlight, from cool subterranean temperatures to midday heat, and from complete submergence in water to an inspissate condition —all in the span of a few minutes.

Sharing the subterranean habitat with the *Euglena* are no less than six species of diatoms, which are present in great numbers. These organisms also migrate rhythmically, and their characteristic pigments add a golden-brown hue to the predominantly green background. Equally abundant—but not visible to the naked eye—is *Salmonella typhosa,* the agent of typhoid fever.

An average *Euglena* cell is 1/200 inch long and contains within its body numerous small chlorophyll-containing plastids that function in photosynthesis. n the middle of the cell is the large nucleus and at the anterior end is the gullet, a channel containing the wo flagella characteristic of most species of *Euglena.* In most species of *Euglena,* the flagella are ong and whiplike, and as they flail about, they propel he organism through the water. In *E. obtusa,* however, the flagella are reduced to diminutive stumps hat do not project out of the protective gullet and are herefore of no use in locomotion. In this species directional movement is the result of crawling, earthworm-like contortions that are well suited for propelling the organism through the soft mud. Also at the nterior end is an agglutination of red granules called he stigma. The *Euglena* will move toward a source of ght (a behavior response of considerable adaptive alue, as these cells construct a great majority of eir food photosynthetically), and it was originally ought that the stigma was a Polyphemus-like “cell e” that guided the organisms toward the light. This le was assigned to the stigma after it was observed at when a tiny beam of light was flashed over the dy surface of a *Euglena,* the organism moved ward the light only when the stigma was illuminated. cent work, however, has shown that the stigma is t the light receptor; instead, this function is performed by the paraflagellar body, a slight swelling at e base of the flagella just beneath the stigma. The gma apparently acts as a light-absorbing shield that rmits directional responses to light by the intermittent shading of the paraflagellar body. Thus, in this ganism the flagella have lost their traditional locomotive function and have become sense organelles. is is not as exceptional as it might seem: the rod ls—the retinal photosensitive structures in the eye of man—are also flagella that have been remodeled by evolution into light receptors.



The vertical-migration rhythm of *Euglena* is just another example of a class of organismic behavior patterns referred to as biological rhythms. Rhythmical behavior is quite common among plants and animals and can usually be classified into either *solar-day* rhythms, in which the organism is active only once a day (as with man), or *tidal* rhythms, in which an organism has two active periods during an interval just slightly longer than a day (as with certain semiterrestrial crabs that scurry about on the shoreline during each low tide). The *Euglena* rhythm is unique, however, in that the organism appears on the surface only during daytime low tides. Appearance only during the daylight hours could be considered adequate grounds to classify this migratory behavior as a solar-day rhythm. This is not quite accurate, however, as the cells emerge only during ebb tides, which in turn come 50 minutes later each day. Because of this, the rhythm could be deemed tidal, except that the cells never emerge during nighttime low tides. Therefore, this unusual rhythmic behavior is perhaps best considered a *quasi-tidal* rhythm.

We had to develop a precise method of studying this rhythm in detail and, after several futile attempts, an exceedingly simple method was adopted. Just as the ebbing tide uncovered a portion of the riverbank, we placed numerous small pieces of porous paper (similar in quality to household facial tissue) on the damp mud. The *Euglena,* in their migratory ascent to daylight, tunneled up through the black mud and passed unwittingly into the interstices of the paper. It was then a simple matter to remove a paper periodically, wash out the *Euglena* in a drop of water, and count the number present under the microscope. This procedure nicely separated the *Euglena* from the typhogenic mud and gave quite reproducible results. Some of the curves obtained using this method are seen in Graph 1 (*page 63*). During the late winter months, when the hours of daylight are limited, the cells appear on the surface of the mud only once a day (*Graph 1, A*). Throughout the long days of summer, the duration of daylight is of sufficient length to encompass two successive low tides, and the migratory rhythm becomes diphasic, that is, the cells emerge both in the morning and evening hours (*Graph 1, B*).

In order to study this rhythmic behavior in controlled conditions, samples of *Euglena*-bearing mud were carefully collected in small dishes and transported to the laboratory. They weathered this drastic handling quite well. When placed in culture rooms where the light and temperature could be rigorously controlled, they lived for at least a month—continuing their vertical migrations all the while. Here the dishes could be viewed directly under the microscope, and using light reflected from above, the number of cells on the surface of the mud could be periodically determined. This technique was much superior to the squares-of-paper method used in field observations, because it made possible prolonged observations of the same organisms in an intact and relatively undisturbed segment of their natural habitat.

In the initial experiments the lights in the culture room were turned on between 7:00 A.M. and 5:30 P.M. to keep the cells in simulated day–night conditions. The temperature was held constant, and there was, of course, no tidal flow. Under these conditions the vertical-migration rhythm continued. Soon after the lights were turned on, the cells began to emerge onto the surface, reached a constant maximum density (giving rise to the distinct, flat-topped pattern of the curves in Graph 2, *A*), and then reburrowed into the mud in anticipation of darkness. Surprisingly, in these conditions, this was a strictly solar-day rhythm: The *Euglena* appeared on the surface of the mud at the same time each day, rather than emerging 50 minutes later each day as they do in their natural habitat. The quasi-tidal frequency had disappeared.

Since the tidal nature of the rhythm had disappeared when the cells were removed from the ebb and flow of tidal waters, we could assume a direct cause and effect relationship. Continuing this line of reasoning, it would seem to follow that since environmental factors appear to control the rhythmic behavior, if the day–night cycles were eliminated, then the vertical-migration rhythm would also disappear. Thus, when the cells were put in constant darkness, they burrowed into the mud and never appeared on the surface again. If, however, the cells were subjected to continuous light of constant intensity, the rhythm persisted for as long as 28 days (*Graph 2, B*) in a form similar to that observed in the alternating light–dark periods. A remarkable feat!

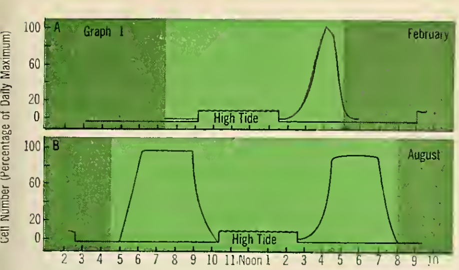
The great majority of other plant and animal rhythms studied in the laboratory also have this enigmatic property of persisting in the absence of the most obvious time-giving cyclic forces of the natural environment: alternation of day and night and the temperature fluctuations dependent on these light–dark changes. This mysterious ability to keep track of time is attributed to an autonomous timer mechanism that resides within the organism and is popularly called "the biological clock." At present, little is known about the actual nature of this mechanism, but following modern tradition, most biologists believe it to be a complex biochemical system that has the over-all property of keeping time.

Thus far, all attempts at direct examination of the clock, via chemical manipulations, etc., have been unsuccessful. A less direct approach is to attempt to manipulate experimentally the end product of the clock's action—the overt rhythm—in hopes of elucidating new properties of rhythmic processes. These properties, in turn, may then be used together to construct a hypothetical model of the clock that, hopefully, will be a reasonable facsimile. We chose this latter approach and subjected the cells to a variety of environmental situations in order to see the effect of these factors on the vertical-migration rhythm.

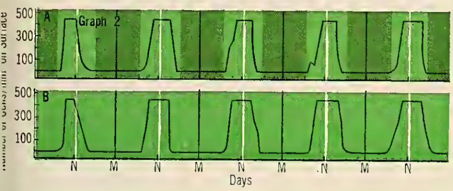
Light, of course, plays a paramount role in the expression of the *Euglena* rhythm, for when the cells a
maintained in darkness in the laboratory they will n
come to the surface. Therefore, the first series of e
periments was designed to study the various roles
light. By covering segments of freshly exposed mud c
the riverbank with opaque screens just as the ti
ebbed, it was found that the cells in these darken
areas never emerged from the mud, although the e
posed neighboring muds soon became green with cell
When the covers were removed, however, the cel
quickly wriggled up out of the mud into the dayligh
Covering cells already on the surface caused them
reburrow. It is therefore obvious that light is intimate
involved in the manifestation of the rhythm and
necessary, first, to bring the cells to the surface, a
secondly, to hold them there for some critical tim

In the next experiment the cells were brought in
the laboratory, and equal numbers of replicate sa
ples were placed in each of several constant light i
tensities (26, 98, and 212 foot-candles) at a consta
temperature. The rhythm persisted in each of the
conditions, but the shape of the daily curves varied
a constant and informative manner. In 212 foot-ca
dles, the *Euglena* appeared on the surface sooner, a
remained there longer, than at the lower light inten
ties. Also, the number of cells amassed on the surfa
at the lowest intensity never equalled the concent
tions in the two higher light intensities. These resu
are summarized in Graph 3, where for simplicity
presentation several response curves in each of t
test light intensities have been averaged together.

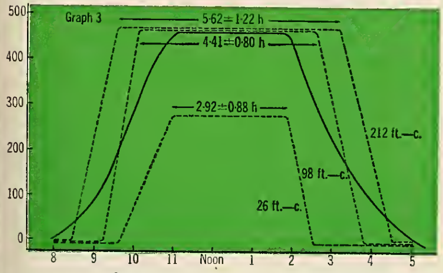
In interpreting these results a rather interesti
possibility arises. Suppose that the *Euglena* have
solar-day rhythm in their responsiveness to light a
that this rhythm is composed of a period in which lig
is attractive, alternating with a period in which t
Euglena are repelled by, or indifferent to, light. T
positive phase (when light is attractive) of such
hypothetical rhythm is represented graphically by t
bold line superimposed over the curves in Graph 3 a
is intended to indicate that the intensity of photo
sponsiveness gradually builds up to a broad maxim
(here centered over midday) and then declines ag
to indifference. Comparison of the bold curve with t
results obtained in the various light intensities sugge
that a rhythm of this nature may be a reality; thus,
9:00 A.M. the cells would be in an initial, low pho
responsive state and, therefore, only slightly attrac
to light. At this time, only bright light (212 foot-c
dles) could initiate emergence from the mud. W
time (at 9:30, for example), when the *Euglena* h
reached a higher level of photoresponsiveness, a lov
light intensity (98 foot-candles) would also be su
cient to bring about emergence. Only when the ce
were in their most responsive state would an intens
as low as 26 foot-candles (a subthreshold amount
some of the population) bring them to the surfa
After the peak in the rhythm of photoresponsiven
is past, indifference ensues, and the cells are no lon
bound to the surface—they burrow. At night just
opposite is true: light has no attractive effect as
clearly shown in cells maintained under constant
lumination (*Graph 2, B*); the cells never appear



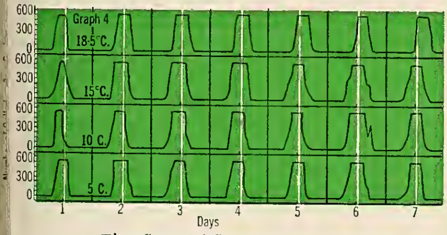
In field observations, the vertical-migration rhythm of the Euglena *is governed by tides, and it changes according to season. In late winter the cells appear on the surface of the mud only once a day, but in summer, daylight is of sufficient length to encompass two successive low tides, and migratory rhythm becomes diphasic.*



Laboratory studies control light regimes and remove tidal influence. In alternating light–dark cycle (A), *the rhythm is diurnal and not tidal, with the* Euglena *appearing at the same time each day. Surprisingly, under continuous illumination and constant temperature the rhythm continues the same* (B). *Under constant darkness, however, the cells burrow and do not reappear.*



The effect of various, constant light intensities is seen in response curves. With greater light, more Euglena *appear sooner and stay longer. The bold curve represents a hypothetical solar-day rhythm based on alternating attraction and indifference to light.*



The effect of different constant temperatures is negligible, and the vertical-migration rhythm does not noticeably alter under most temperatures. Thus the Euglena's *clock must be either insensitive to temperature or must compensate for it in some way.*

the surface during the night. This certainly suggests that the *Euglena* must undergo a daily change, a rhythm, in responsiveness to light. The feasibility of the existence of such a rhythm is indirectly enhanced by the work of Dr. R. Pohl in Germany and Drs. Victor Bruce and Colin Rittendrigh at Princeton University, who have, respectively, described and confirmed a pronounced photoresponse rhythm in a near relative, *Euglena gracilis*. They found that during daylight hours this species was strongly attracted to light, while at night it was not. When plotted graphically the curves they obtained for the positive phase of the rhythm closely resembled the bold curve in Graph 3.

It is therefore possible to postulate that the vertical–migration rhythm is a secondary and unavoidable consequence of a more fundamental, diurnal photoresponsive rhythm. The migration rhythm would also have a diurnal period in nature if it were not for one particular property of Avon water: its excessive turbidity. So much silt and detritus is suspended in the water that sunlight is virtually screened out in the top few inches of water. Therefore, accompanying each flooding tide is a curtain of darkness, and these dark periods prevent the cells from appearing on the surface, transforming the fundamental solar-day rhythm into one of quasi-tidal frequency.

As a result of these experiments we have more insight into the controlling factors of the migratory rhythms of *Euglena obtusa*, but we still have learned little about the actual working mechanism of the clock that controls the overt rhythm. We therefore approached the problem from a different direction.

The tidal habitat in the higher latitudes is characterized by extreme changes in several environmental factors, one of the most profound being the sudden changes in temperature. For example, the surface-mud temperature on the Avon may drop from 30° to 6° C. (86° to 43° F.) in a matter of a few minutes as the mud flat is covered by the returning tide, and the *Euglena* must weather these changes. Such vicissitudes of temperature have, of course, profound effects on the kinetics of metabolic systems. In general, metabolic processes double or triple the rate at which they run for every 10 degree rise in temperature. Assuming that the causative mechanism of a rhythm (the clock) is actually a biochemical entity within the cell, then it should respond to changes in temperature in a way similar to other cellular chemical processes. If, for instance, the body temperature of a *Euglena* is raised, then the clock, just as the rest of the general body metabolism, should run at an augmented rate. With the speeding up of the clock, the overt rhythm under its control will also change: The period of the rhythm (the interval of time elapsed between consecutive daily appearances of the cells on the surface) should be shortened, as there is an inverse relationship between length of period and the rate at which the clock is running. As the temperature is further increased, the clock should run even faster, and the period of the rhythm would be expected to become

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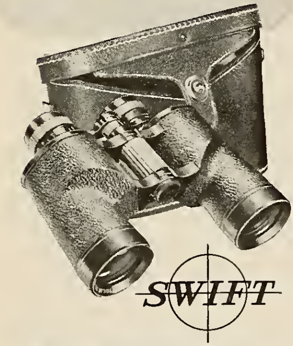

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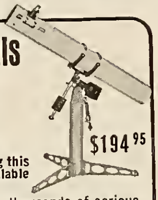

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even shorter. By way of analogy, envision a grandfather clock that sounds the hours of the day with chimes. If the pendulum—the pacemaker governing the rate at which the clock runs—is shortened, the hands of the clock rotate faster and the interval of time between successive chiming is decreased. The more the pendulum is shortened, the more contracted the interval between the signaled hours. Returning to the *Euglena* rhythm, if we studied the cells for days at a time in a host of different constant temperatures and found that the period of the rhythm changed accordingly, we would have quite suggestive evidence that our speculation is correct—the clock might well be a biochemical oscillator.

The potential malleability of the period of the vertical migration was treated in the following way: Replicate samples of *Euglena*-bearing mud were placed in constant temperature rooms at temperatures of 5°, 10°, 15°, and 18.5° C.; in constant light (98 foot-candles) and, again, away from the influence of the tidal flow. The rhythms were followed for periods of up to 15 days in these conditions.

Between 5° and 15° C. the period and amplitude of the rhythm were unaffected (*Graph 4*). Since the rhythm is only a vacillation of the number of cells on the mud surface, no difference in amplitude would be expected. The period of the rhythm is estimated to be about 24 hours at each of the temperatures within this range. Therefore, the clock was not affected by these differences in temperature. This means that the clockwork is either built on something other than a biochemical foundation or that intimately associated with the clock is a rather precise temperature-compensating system—a kind of servomechanism designed to maintain the clock at a constant speed in spite of temperature changes. Philosophically, any clock, animate or inanimate, must run at a constant speed regardless of the ambient temperature; for if it varied with the caprice of the temperature, it would no longer register time, but instead, might function as a rathe complicated thermometer. Therefore, all clocks must be insensitiv to temperature change or possess compensatory mechanism to correc for such changes. The latter ma be the case in the *Euglena* rhythm

Returning to Graph 4, notic that the period of the rhythm i cells maintained at 18.5° C. (th highest temperature obtainabl with the facilities at hand) lengthened, becoming approximately 24. hours long. It is doubly surprisin to find a lengthening of the perio when a priori one would predict shortening, or at most, no change a all. This unexpected result certainl provides substance for speculatio For example, it may well indica that a temperature-compensatir mechanism is associated with th clock, for the lengthening of th period certainly suggests that this highest temperature, the compensating mechanism performe too well and that overcompensatic had taken place. Therefore, n until the compensating mechanis malfunctioned slightly was its pre ence manifest. Final confirmatic of the existence of a temperatur compensating mechanism assoc ated with the biological clock awai biochemical inquiry.

It should be quite apparent th the study of the rhythmic jou neys of *Euglena obtusa* is still in initial stages and that many of t conclusions drawn from the wo are still highly speculative. Eme ing from these pristine findin however, is a distinct realization the exceeding complexity of t daily lives of these minute cre tures, organisms that, because th entire bodies consist of one c are often erroneously consider "simple." In reality, these little ce are much more complex and ver tile than any of the cells in the bo of man. Still, they are useful s jects for study because, in spite their complexity, they have v precise timing mechanisms and e easily handled in the laborato Hopefully, we will someday be a to force them to reveal all the crets of how their tiny clocks ac ally work.

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'E, PHOENICIAN
SS OF LOVE
e, circa 800 B.C.
tta original at
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Astarte, the Phoenician Goddess of Love—known as Ishtar to the Babylonians and Aphrodite to the Greeks—was the great goddess of motherhood and fertility. Personifying all the reproductive energies of nature, she was worshipped under different names, but with a similarity of myth and ritual by many peoples of Western Asia and the Mediterranean.

The terracotta Astarte plaque reproduced here dates from circa 800 B.C. and comes from ancient Palestine, homeland of the Phoenicians. Pottery plaques of this type, a common class of religious objects in the Late Bronze and Early Iron Ages, were probably used as votive offerings. Mounted on red velour in gold antiqued frame.

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Presumably Totonac,
(800 A.D.-1300 A.D.)
Philadelphia Museum of Art

This cheery head from Southern Cruz is one of the very few humorous ures found in American antiquity. culture it represents is not yet known, the fact that it is mold-made dates late Classic. Warm and whimsical, wit mysterious single right earring, it m a really provocative piece.

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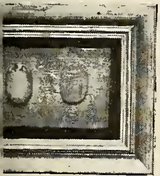

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Egypt, about 600 B.
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This long-legged, golden-bronze wading bi was regarded as sacred by the Egyptians.

The ancient Egyptians always placed a gr emphasis on the hereafter. When they look at the gentle Ibis, they saw not a bird, their god Thoth, who was supposed to h on Judgement Day and to have kept reco of both men and the gods. Thoth was oft depicted as a man with the head or neck an Ibis, or, as here, entirely as an Ibis.

OR-4, height 4½" .... $15.
Plus $1.50 handling and shipping costs.

' A MAN, Egyptian
nite, circa 945 B.C.
ers Art Gallery,
, Maryland

sly carved black granite d from the solemn, pow- es of the great Middle about 2,000 B.C. The ftsmanship displayed in carving of this very hard t have defied any tools od. Arrangement of the ss bands without a cen- npossible in real life is a pattern device.

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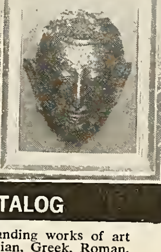

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BOOK REVIEWS *continued from page 19*

Director of The New York Botanical Garden, served as general editor, and the author admits that he "pulled me out of many a hole." This book is primarily the work of a mature and profound botanical scholar, Dr. Rickett. It has behind it the tremendous academic resources of one of the world's great botanical gardens, especially its library and magnificent herbarium.

The colored illustrations were made at Ipswich, England, on special paper; some required as many as seven printings. The text and binding were done in the United States.

There are a few botanical classics that are such masterpieces that no one has had the desire or audacity to try to do them better; some have never been revised. *Wild Flowers of the United States* will find a niche among these.

At this time of increasing appreciation of conservation, it is entirely fitting that the first copy of this book was presented to Mrs. Lyndon B. Johnson.

Dr. Edwin B. Matzke, Chairman of the Department of Biological Sciences at Columbia University, specializes in the morphology of flowering plants.

MODES OF REPRODUCTION IN FISHES, by Charles M. Breder, Jr. and Donn Eric Rosen. *Natural History Press, $17.50; 941 pp., illus.*

THIS remarkable and important book constitutes an encylopedic reference-summary of what is known about the breeding habits of all fishes, arranged according to the taxonomic groupings into which fishes are usually classified. The fantastic number of publications combed for information is indicated by the bibliography, which alone runs to 232 pages; moreover, citations included in Dean's "Bibliography of Fishes," which covers the literature up to about 1914, are not even included here. In addition, 56 pages are given to tables that set forth briefly the secondary sex characteristics, mating data, kind of breeding sites, types of eggs (or young in live-born forms), parental care, and breeding migrations for each family of fishes. The figures used in the charts or tables—principally small outline drawings to show the general appearance of one typical member of each fish family—are the only illustrations in the book. The 31-page summary briefly sketches the main types of reproductive modes shown by the jawless hagfishes and lampreys, the more primitive jawed forms, and the teleosts. A 31-page index is restricted to zoological names of species and families.

This is not, then, a "popular" book, or one for leisurely reading, even by the
ichthyologist, although little of the te
would be beyond the ken of an intel
gent layman. It is a zoological referen
work, and one of the most importa
ever published on fishes. This is b
cause, aside from short chapters
general books on fishes and a few cu
sory accounts of nest building and p
rental care, there has never been
extensive publication devoted to the
productive habits of all fishes. As
result, even many ichthyologists ha
been unaware of the nature and varie
of breeding habits exhibited throug
out the twenty-five or thirty thousa
species of living fishes.

The book does not cover the etholo
ical analysis of breeding behavi
physiology of reproduction, egg dev
opment, or larval forms. In each ce
the treatment covers breeding seas
breeding site, breeding migration,
ondary sex characters, sex discrim
tion, competition for mates, courtsh
mating, and parental care, if any, in
far as these are known for any part
lar species or family. I had rat
hoped to find some theorizing in reg
to the general taxonomic or evolut
ary conclusions that might be dr
from the first major attempt to desc
the known types of breeding ha
found among fishes. However,
Breder decided that the theoretical
pects of the subject would be rig
excluded from the book itself. Th
disappointing, because each of the
thors has derived excellent and inte
ing theoretical results from o
research.

I have often contended that prob
between one third and one half o
kinds of living fishes exhibit some
of nesting or parental care of the
or both, and that such habits are the
rather than the exception unless
mode of life (such as pelagic habit

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iviparity) prevents it. Many ichthyolo- ists have doubted this, but because the attern of breeding behavior is usually easonably uniform within each family f fishes, the present book documents ıe contention in an impressive way. ven the lowly, jawless lampreys pre- are a simple nest, and the general istribution of nesting and parental ıre among the more primitive seden- ıry bony fishes may be considered to ive considerable support to the theory ıat parental care of the eggs is primi- ve among them and that non-care is a pecialized, derivative behavior of shes with specialized, derivative hab- s. There will undoubtedly be much ıeorizing now that Drs. Breder and osen have provided the factual basis.

From perusal of the sections on those shes best known to me, the authors ppear to have missed remarkably little an important nature on the breeding ıbits of fishes. But there are excep- ons. The spectacular breeding migra- on of the famed dorados (*Salminus*) South America, during which these eat fish leap rapids and waterfalls in e same manner as salmon, is unmen- oned, although it is referred to in veral books published in South Amer- ı. This indicates the only weakness in verage of the literature that I have ınd in the book. The scientific and uarium periodicals have been most haustively covered, but a number of nipopular (or semiscientific!) books blished elsewhere than in North ıerica and Europe have been passed ːr. However, few users of this great rk will have reason to complain out overlooked literature. What there ılly is to complain about is the num- ː of gaping voids in our knowledge fish habits. Drs. Breder and Rosen ow clearly where and what those ds are.

G. S. Myers
Stanford University

E World of Reptiles, by Angus llairs and Richard Carrington. *erican Elsevier Publishing Co., 75; 153 pp., illus.*

ublishers have become aware of the demand for authoritative books ling with reptiles, and perhaps they erve credit for having helped create demand. Until the turn of the cen- y, when Hans Gadow's volume on ohibians and reptiles appeared in ıe Cambridge Natural History," few ıralists had access to comprehensive ounts of the reptiles. During the uing decades virtually the only non- ınical books dealing with these ani- s were those written by the late mond L. Ditmars. Beginning in 7, when The Viking Press issued ford H. Pope's *Snakes Alive and How They Live*, the books by Ditmars rapidly became outmoded. Pope prepared an excellent account of the turtles, which Alfred A. Knopf published in 1939, and shortly thereafter the Comstock Publishing Company began to issue the useful "Handbooks of American Natural History," inspired and edited by A. H. Wright. In the next few years first-rate books about reptiles had been published by a number of major publishing companies.

Each book that appears seems to whet the demand for more. It can scarcely be doubted that ready access to information has aroused an unprecedented interest in reptiles. Amateurs have organized countless herpetological societies in the United States, and several of these organizations now issue journals. Articles dealing with reptiles in technical journals are approximately four times as numerous today as they were two or three decades ago. Serious students in the field read or scan at least 1,000 accounts annually merely to keep abreast of the advances. Any account that summarizes information is welcome, therefore, and *The World of Reptiles* is no exception. The text was prepared by two able writers: Bellairs is well known to graduate students in the United States and Britain as the author of a compact volume on reptiles, and Richard Carrington, a professional author and editor, has dealt successfully with topics ranging from elephants to a *Biography of the Sea.*

Plainly, Bellairs and Carrington have the qualifications to write about reptiles, and their book should meet the requirements of those who want a concise, informative, readable introduction to this group of vertebrates. A larger book would have been required for an exhaustive summary. Little space is wasted, however, in approximately 130 pages of well-illustrated text, to which the authors have appended a discussion of scientific names, a brief classification, a bibliography, and an index. An emerald tree boa is illustrated in a colored frontispiece, and photographs reproduced in 16 plates portray 32 representative species.

Understandably, the authors of *The World of Reptiles* emphasize those aspects of the habits, behavior, and structure of reptiles that have the widest appeal. A short introduction mentioning extinct forms and the ancestries of living reptiles precedes an excellent chapter that discusses the attributes and peculiarities of these vertebrates. Thereafter, the text takes up living reptiles group by group. A chapter dealing with turtles is followed by one on the lizards and the tuatara, by one on snakes, and finally by a short chapter on crocodilians.

Bellairs and Carrington employ a few

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outmoded scientific names, and in some instances recent literature has escaped their attention. It is disconcerting to note that they use the adjective "rudimentary" to describe structures more accurately called vestigial, and they have inadvertently referred to a fangless water snake, *Natrix maura*, as being "viperine." Only the specialist will be disturbed by trivial errors of this sort, however, for few books are more authoritative. Students will be amply rewarded for the small amount of time required to read *The World of Reptiles.*

C. M. BOGERT
The American Museum

FOREVER WILD: THE ADIRONDACKS, by Eliot Porter. *The Adirondack Museum/Harper & Row, $20.00; 164 pp., illus.*

THIS is one of those books that sends me to reference books even before I have done with marveling at its superb pictures and splendidly chosen captions. I suspect that was one reason for the volume itself—to make one admire, marvel. and want to learn more.

I found that New York's Adirondack State Park. which comprises about 5,700.000 acres in 12 of New York's northern counties, is the biggest state park in this country. It is more than twice as big as Yellowstone (the largest of our national parks). two and a half times as big as Mount McKinley Park in Alaska. and more than ten times as big as the Great Smoky Mountains Park. It is more than twice as big as the biggest national monument. Katmai, in Alaska. And. in sheer acreage, the Adirondack park is bigger than all of Massachusetts or New Jersey. It is a realm within the Empire State and. miracle of miracles. it is, by constitutional amendment. to be kept forever wild. So much for the statistics, which are too little known.

Forever Wild: The Adirondacks is a book about that vast monument to conservation. It is primarily a picture book. with splendid reproductions of the superb color photography of Eliot Porter. Except for a brief introduction by Harold K. Hockschild, president of the Adirondack Museum, its only text is the caption material, taken from the writings of the late William Chapman White. The captions perfectly complement the pictures, yet they stand by themselves as a sensitive, poetically philosophical summary of the aspect and ultimate meaning of the whole Adirondack region. Consider the following examples:

"In a world where man finds little permanence, he can always fix on his mountains, forever unchanging, yesterday, today and tomorrow. He may go. but they remain." "The mountains of the Eastern seaboard seem to have bee in their places since time began. What more, they have been—at least the Ad rondacks, which probably are the ol est mountains in America." "In th Adirondacks a man is never marke old until he is unable to get out an walk the woods for at least one da each year."

As for the pictures, they range fro intimate details of leaves, grasses, w ter. wildflowers. and rocks to magni cent panoramas of mountains, lake and forests. It seems impossible th anyone has ever surpassed these pi tures of mountains under storm cloud woodland in autumn leaf, placid pon at sunset, or birch trees. This is Eli Porter at his superb best. And the r production is flawless.

The book leaves me with only o question. Why was it not organiz logically, spring to spring? Instea particularly in the first half, it ski about among the seasons, from f green of midsummer to icy white midwinter, from autumn color to b geoning spring again. If there was photographic reason, I missed it. T conservation message is there, and t eloquence of appreciation; both wou have been more emphatic with a quence closer to that of nature itse

HAL BORLA
Author and Natura

THE LIVING WORLD OF THE SEA, by W liam J. Cromie. *Prentice-Hall, $6.9 343 pp., illus.*

IN recent years more and more att tion has been given to the study the oceans, until today the field oceanology is a vast complex of ma related disciplines, including mar biology. An introduction to marine b ogy for the layman is, therefore, order, and *The Living World of the* is a model of clear, accurate, and th oughly entertaining writing abou complex scientific subject. In read the book one never loses the feeling the author was thoroughly fascina by his subject and sincerely wanted readers to share that fascination.

In a volume of this size only cer topics could be treated, and Cromie made his choices well. The book be with the latest theories on how when the earth was formed and the quences of events that led to the ev tion of living organisms as we them today. From here the author ceeds with a discussion of the co tions faced by marine organisms then treats the major groups of pl and animals that occur in the sea. F plankton to whales. each categor discussed in just the right amoun detail to keep the reader's atten and at the same time give him the

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important facts. Such flamboyant topics as the coelacanth, sharks, and giant squids and sea monsters are put into their proper perspectives. The final chapter is a realistic appraisal of the problems and possibilities of increased use of the sea by mankind.

Throughout the book, matters of conjecture are clearly distinguished from thoroughly established facts. This is popular science writing at its best. It is entertaining, yet precise, and there are no wasted words—every sentence counts. At the same time the style is light enough to hold the reader's interest. It is exactly what marine biology needed.

C. LAVETT SMITH
The American Museum

HANDS ON THE PAST, edited by C. W. Ceram. *Alfred A. Knopf, $8.95; 434 pp., illus.*

KURT W. MAREK, better known to his readers by his pen name, C. W. Ceram, is a most infuriating author! As the editor of this anthology, his familiar storytelling genius shines through both the introductions heading each selection and the particular material he selected for the volume. Not even the most hardened professional in the field of archeology, not to mention the layman caught up by the spell of the past, can muster enough objections to this latest literary foray of Ceram's to put it aside half-read. This, in spite of the rather ponderous size of the book and the often downright, completely boring nature of certain of the selections. The "adventure" of archeology, actual and spiritual, promised in the Foreword is, indeed, met throughout the entire volume.

As is common with other works of this author, clear-cut divisions between sections of content are cavalierly ignored, and the seven major parts of the anthology flow in and around each other at will. Selection titles, too, often completely hide the actuality of the content, in typical Ceram fashion. Hence, in Part One, "In Place of an Introduction," Woolley's classic definition of an "ideal archaeologist" provides the basis for ringing in the Olympia Convention, along with selections on "How to Buy Antiquities" and "How to Steal Antiquities." "The Book of the Statues" (Part Two) includes some famous discoveries along that line, but also leaves room for W. Taylour's article on Ventris' decipherment of Linear B. "The Book of the Pyramids" (Part Three) keeps fairly to its avowed subject (except for a coffee session with Amelia Edwards at Abu Simbel) while "The Book of the Towers" (Part Four) goes from the decipherment of cuneiform by Rawlinson to Hilprecht's

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discussion of ancient technology. Also, Part Six, allegedly having to do with "Steps," discusses the pyramids of Cholula, the problem of elephants in America by G. E. Smith, and the bridge of San Luis Rey. Part Seven of the book *does* restrict itself to "New Methods in Archaeology," but, unfortunately, in so doing lacks the spark of the preceding sections.

The selections vary individually, as well—from the pedantic and the stuffy, to the pompous and the extravagant. They mirror the many-faceted range of archeology (from Roman Britain and the Near East to Yucatán) and the often fantastic people engaged in it. National differences also appear, as the selections veer from the extravagantly named finds of the British and the internal squabbles of the French, to the minute obscurantism of the Germans and the rather homespun style of Americans. Ceram has driven home some messages via his choice of selections: tales of early methods that bring shudders down the spines of modern professionals; the turmoil and bloody rivalries of the field; the pathetic tragedies in the lives of famous archeologists; the struggles related to both securing antiquities and to receiving recognition for discoveries; and the "trials" of field archeology conducted amid fever, haggling, flies, cupidity, and wet feet. The wide range of men in the discipline is also clear, as the volume repeats the words of circus strong men, millionaires, adventurers, scientists, and a few fanatics. One consolation, for those of us in the field, emerges in the notation made in the author's introduction of Jean de Waldeck—he *published* at the age of 100!

The book is also a veritable *Who's Who* of the discipline: Woolley, Schliemann, Evans, Mariette, Belzoni, Maspero, Petrie, Budge, Layard, Botta, Von Humboldt, Cousteau, Bibby, and many others are heard from. The notorious along with the justly venerated figures of archeology stand side-by-side. There are fine selections of first-hand "inside stories" of great discoveries (Brugsch's classic hoard of mummies, Budge and the Amarna Tablets, Carter and King Tutankhamen's tomb, Wright at Hama, Bossert at Kara Tepe, Ruz at Palenque) that combine the thrills, the uncertainties, the workings of sheer chance, and the often painstaking months and years of labor that brought them about.

This volume is also somewhat of a reference work, with most of the major discoveries reflected, most of the divisions of the field represented. There is broad coverage geographically and temporally, admirable introductions supplying biographical data, and an excellent index to back it all up. One could have wished that the tantalizing
vignettes of the careers of the arche
ogists involved, which head each sele
tion, could have recorded how the wo
being reported actually ended, but t
source-bibliography at the end of t
volume at least provides the reader wi
a place to follow up items of interest.

I found the book highly informati
interesting, and a distinct contributi
to the more general understanding a
appreciation of the manifold facets
the adventure of this science, which
also an art.

PHILIP C. HAMMO
Brandeis Univers

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ject. Neither attempts to present a
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their parts. Since the photograph
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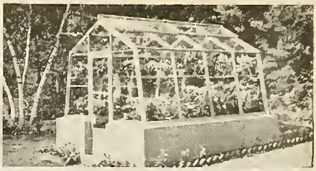

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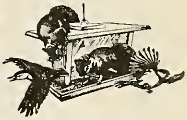

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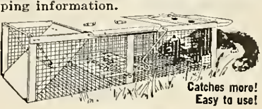
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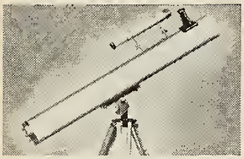

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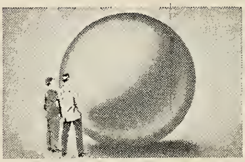

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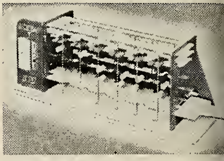

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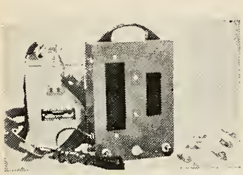

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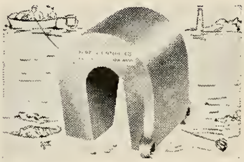

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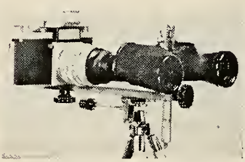

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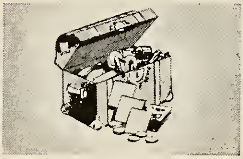

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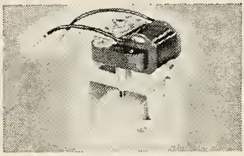

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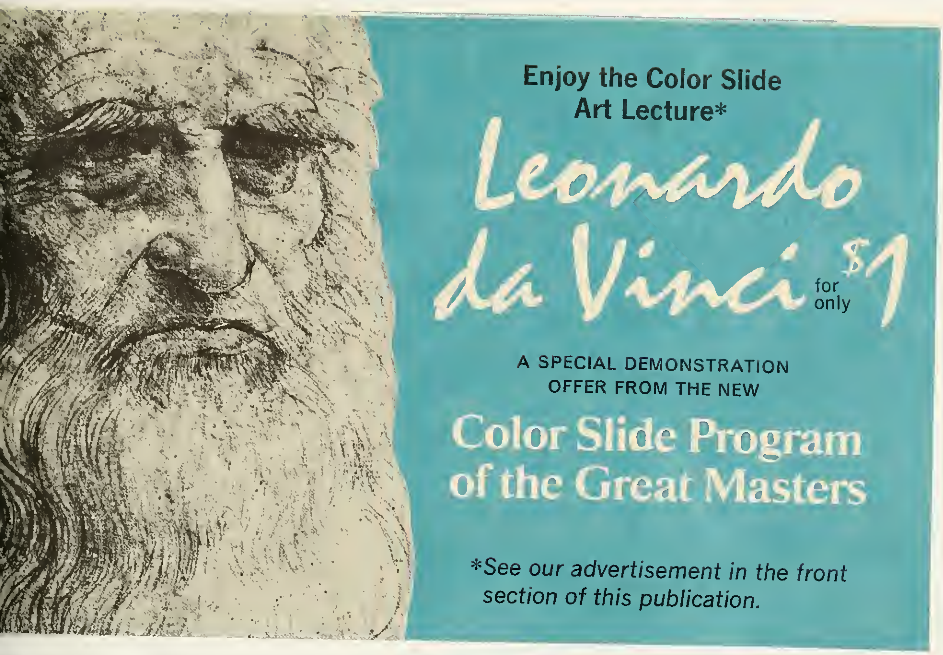

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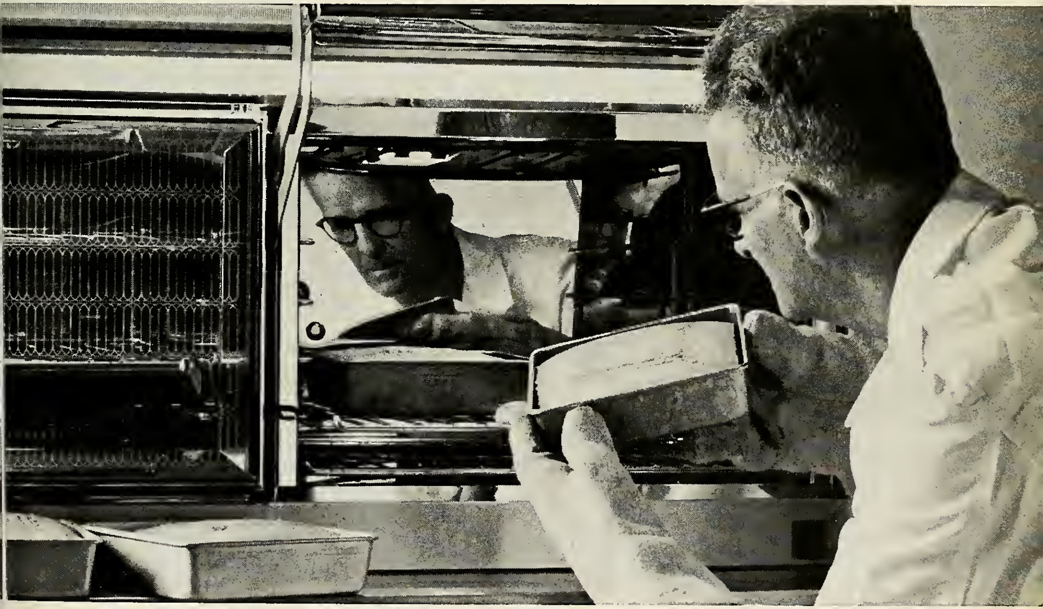

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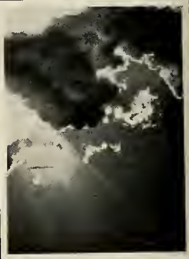

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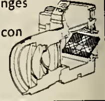

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Natural History

March 1967 • 70¢

The Birth of an Island

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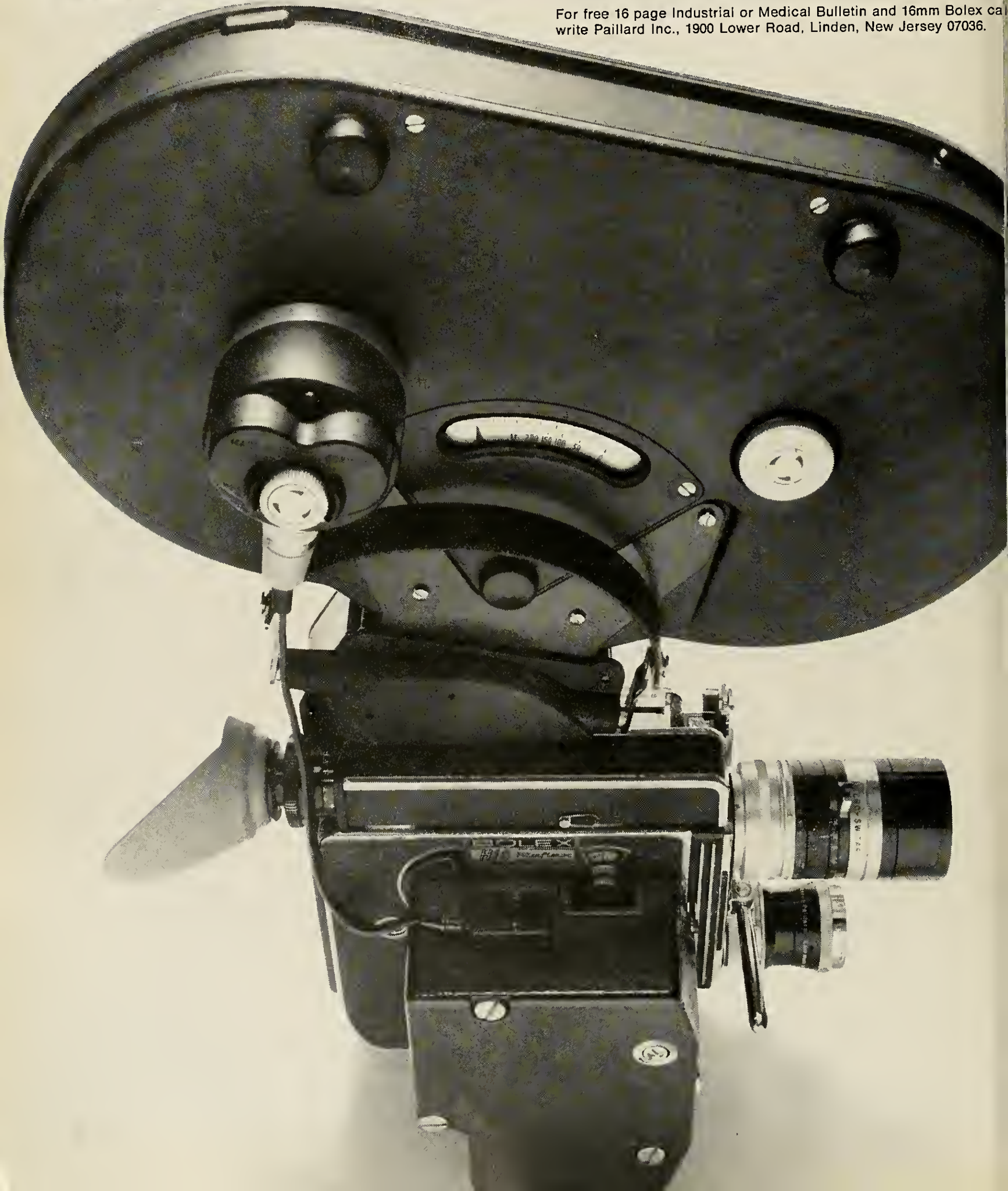

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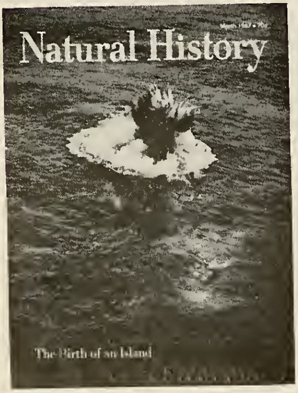

Natural History
Incorporating Nature Magazine
THE JOURNAL OF THE AMERICAN MUSEUM OF NATURAL HISTORY

Vol. LXXVI MARCH 1967 No. 3

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COVER: Approximately six weeks after eruptions began on Surtsey, the volcanic island whose emergence is depicted in the article that begins on page 22, a new series of submarine eruptions occurred a mile and a half northeast, providing observers the opportunity to witness an early phase of island formation. In his book, *Surtsey*, Icelandic geologist Sigurdur Thorarinsson writes that "When flying very low straight above these new vents quick flashes from fire under the surface could be seen at intervals of half a second, causing abrupt concentric waves all around that made the sea look like quivering jelly."

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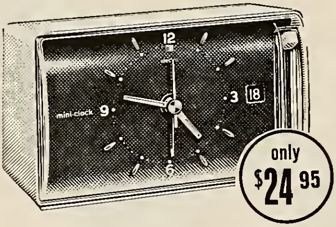

They're the same people who don't mind living with "the approximate" time or walking into a Five-and-Dime every six months to buy another new $8.95 wind-up tick-tock.

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Marvin Harris presented "T
Myth of the Sacred Cow" because
believes "the irrational, non-ec
nomic, and exotic aspects of t
Indian cattle complex are grea
overemphasized at the expense
rational, economic, and munda
interpretations." Dr. Harris is P
fessor of Anthropology at Columb
University, where he was chairm
of the department from 1963-66.
has written other articles on the e
nomic aspects of anthropology a
is currently preparing a history
the theories of cultural anthropolo
The original article on "The Cultu
Ecology of India's Sacred Catt
appeared in the February, 19
issue of *Current Anthropology.*

Paul A. Johnsgard is Associ
Professor of Zoology and Physiol
at the University of Nebraska. D
ing the past four summers his f
research has taken him to Alas
Australia, South America, and
West Indies to study the compa
tive behavior of the waterfowl f
ily Anatidae. Grouse lek display
terests him because of its similari

Paul A. Johnsgard

Julian Kane

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e social displays of waterfowl.
ohnsgard is the author of *Hand-*
of Waterfowl Behavior and
ıal Behavior.

ı a 1964 trip to study Icelandic
gy, Julian Kane flew over the
island of Surtsey when the red
ains of lava were still flowing.
Kane teaches earth science at
en City (N.Y.) Senior High
ol and geology at Hofstra Uni-
y. With Brooks Ellis of The
ican Museum, he produced the
Kane Models of Foraminifera
isplay and teaching purposes.
hotographs of Surtsey that il-
te Mr. Kane's article are from
book called *Surtsey: The New*
l in the North Atlantic, by
dur Thorarinsson, to be pub-
this month by Viking.

h James Deetz and Edwin S.
lefsen have spent a great deal
ıe investigating New England
yards for their work in North
ican archeology and anthro-
. Dr. Deetz, Professor of An-
logy at the University of California at Santa Barbara and acting chairman of the department, is also archeological advisor to the Plimoth Plantation in Plymouth, Mass. He received his B.A., M.A., and Ph.D. from Harvard, where he spent 1965-66 as a visiting associate professor. Dr. Deetz's new book, *Invitation to Archaeology,* is to be published by Natural History Press this month. Edwin Dethlefsen, who works with Dr. Deetz, is Unit Director of the Anthropology Curriculum Study Project. He lives and works in Massachusetts. They are studying the vital statistics of colonial New England and the environmental influences on population growth, lifespan, gene flow, and so forth, and frequently use gravestones for data.

Richard D. Estes concludes in this issue his article begun last month on "Predators and Scavengers" in the Ngorongoro Crater in Tanzania. Mr. Estes will complete his doctoral thesis on the behavior and life history of the wildebeest in June, at which time he plans to return to Africa for several years.

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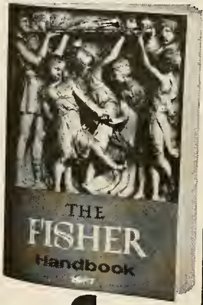

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THE MYTH OF TH

> NEW DELHI, Dec. 1—Prime Minister Indira Gandhi appealed today to India's holy men to stop fasting and agitating against cow slaughter.
>
> In an effort to halt the spreading wave of fasts by the saffron-clad Hindu Sadhus, Mrs. Gandhi wrote directly to Muni Shushil Kumar, president of the All-Party Cow Protection Campaign Committee.
>
> The Muni has announced his intention of starting a fast tomorrow to demand a nationwide ban on the slaughter of cows, which are revered by Hindus as symbols of abundance but whose meat is often eaten by India's Moslem minority.
>
> On Nov. 7 thousands of demonstrators, led by a group of holy men smeared with white ash and draped with garlands of marigolds, rioted in front of Parliament. Eight persons were killed and 47 injured.
>
> *The New York Times*
> December 2, 1966

Among the popular myths of cultural anarchy, none is more widely accepted than that of the Indian sacred cow. Protected by Hindu taboo from being slaughtered and eaten, these supposedly useless animals wander about at will, impeding traffic and, it is reported, damaging crops. Indeed, in some parts of India, aged cattle are even housed in *gosadans*—bovine old-age homes.

But the myth of the sacred cow is part of a widespread overemphasis on the mismanagement of food production by primitive and peasant peoples. One often hears, especially in these times of vast aid programs for the underdeveloped countries of the world, that irrational ideologies and customs prevent the effective use of available food resources.

In the case of the sacred cow, it must be admitted that the Indian dairy industry is among the least efficient in the world. In India, the average annual yield of whole milk per cow has been reported at 413 pounds, as compared with an average of over 5,000 pounds in Europe and the United States. Furthermore, of the 79.4 million cows maintained in 1961, only 20.1 million were milk producers. Among the 47.2 million cows over three years old, 27.2 million were dry and/or not calved. If we go on to accept the proposition that India can make no profit from the negligible slaughter of its enormous cattle supply, we have completed the case for the great cattle bungle. Hence the conclusion of a 1959 Ford Foundation report on India's food problem:

"There is widespread recognition, not only among animal husbandry officials, but among citizens generally, that India's cattle population is far in excess of the available supplies of fodder and feed. . . . At least one third, and possibly as many as one half, of the Indian cattle population may be regarded as surplus in relation to feed supply."

This view is endorsed by government agronomists, and the Indian Ministry of Information insists that "the large animal population is more a liability than an asset in view of our limited land resource." Because of the perpetual food shortage for humans in India, refusal to slaughter cattle seems to prove that the mysterious has triumphed over the practical. Some would even have us believe that in order to preserve his cow the individual farmer is prepared to sacrifice his own life. Such is the myth of the sacred cow.

A better understanding of the cow complex in India involves the answers to the following two questions: (1) Is it true that the rate of reproduction and survival of the Indian population is lowered as a result of the competition between man and cattle for scarce resources? (2) Would the removal of the Hindu taboo on slaughter substantially modify the ecology of Indian foo
production?

The answer to the first question i
that the relation between man an
cattle—both cows and bullocks—i
not competitive, but symbiotic. Th
most obvious part of this symbiosi
is the role played by male cattle i
cultivation. Indian farming is base
on plow agriculture, to which catt
contribute up to 46 per cent of th
labor cost, exclusive of transport an
other activities. Obviously, tracto
are not a realistic alternative.

Despite the existence of 96.3 mi
lion bullocks, of which 68.6 millic
are working animals, India suffe

from a shortage of such animals. It
generally agreed that a pair of bu
ocks is the minimum unit for cul
vation. But a conservatively es
mated 60 million rural househol
dispose of only 80 million worki
cattle and buffaloes. This wou
mean that as many as two-thirds
India's farmers may be short of t
technical minimum. Moreover, unc
existing property relations the bu
ocks cannot be shared among seve
households without further loweri
the productivity of marginal farr
M. B. Desai, an Indian economist,
plains why: ". . . over vast areas, sc
ing and harvesting operations, by t
very nature of things, begin sim
taneously with the outbreak of
first showers and the maturing

ACRED COW

by Marvin Harris

ops respectively and especially the rmer has got to be put through uickly during the first phase of e monsoon. Under these circum- ances, reliance by a farmer on an- her for bullocks is highly risky and e has got, therefore, to maintain his wn pair."

We see, then, that the draft ani- als, which appear to be superfluous om the point of view of what would e needed in a perfectly engineered ciety, turn out to be considerably ss than sufficient in the actual con- xt of Indian agriculture.

But what of the cows? The first ing to note is again obvious. No ws, no bullocks. Of course, the ue is not so easily settled. Although need for bullocks establishes the ed for cows, it does not establish need for 80 million of them. We , however, coming closer to the swer, because we now know that the value of the milk and milk ducts produced by the cows, we st add the value of the 69 million le traction animals also produced.

As well as milk, dung, beef, and hide, India's cattle provide vital traction power. Most farms still lack a pair of bullocks—the minimum unit for cultivation.

Among the other immediate and ortant contributions of the cow is dung. In addition to the relatively or value of dung as plaster in se construction, this material is ia's main cooking fuel. India's in crops cannot be metabolized human beings without cooking. l and oil are, of course, prohibitively expensive for the peasant family. Thus, dung alone provides the needed energy, and cattle provide the dung on a lavish scale. Of the 800 million tons annually bequeathed the Indian countryside, 300 million are consumed in cookery. This amount is the Btu equivalent of 35 million tons of coal or 68 million tons of wood, an impressive amount of Btu's to be plugged into an energy system.

Of the remaining 500 million tons of dung, the largest part is used for manuring. It has been claimed that 160 million tons of this manure is "wasted on hillsides and roads," but it must be noted that some of this probably re-enters the ecological system, since, as we shall see in a moment, the cattle depend upon hillsides and roads for much of their sustenance. (Needless to say, the intensive rainfall agriculture characteristic of large parts of the subcontinent is dependent upon manuring. So vital is this contribution that one scholar argues that substitutes for the manure consumed as fuel "must be supplied, and lavishly, even at a financial loss to government.")

In the present context, the most important point to note about the fuel and manure functions of India's cattle is that old, dry, barren animals do not cease to provide dung. On this score alone, one might expect more caution before the conclusion is reached that the sacred cow is a useless luxury.

Two additional contributions by cattle, including cows, remain to be mentioned. In 1962 India produced 16 million cattle hides. Much of this output is consumed in the manufacture of leather products vital to the traditional farming technology. In addition, despite the Hindu proscription, a considerable amount of beef *is* eaten. Those who stress the quaintness of the beef-eating taboo fail to give proper emphasis to the millions of people in India who have no caste to lose. Not only are there some 55 million members of exterior or untouchable groups, many of whom will consume beef if given the opportunity, but there are also several millions more who are pagan, Christian, or Moslem. It seems likely that a high proportion of the 20 million bovines that die each year get eaten. Moreover, it is quite clear that not all these cattle die a natural death. On the contrary, the very extent of the agitation for antislaughter bills reveals how widespread the slaughter actually is.

We see that to the contribution of the cow as a producer of milk, we must add the production of meat, bullocks, manure, fuel, and hides. The extent of the symbiosis between man and cow, however, is not thereby demonstrated. There still remains

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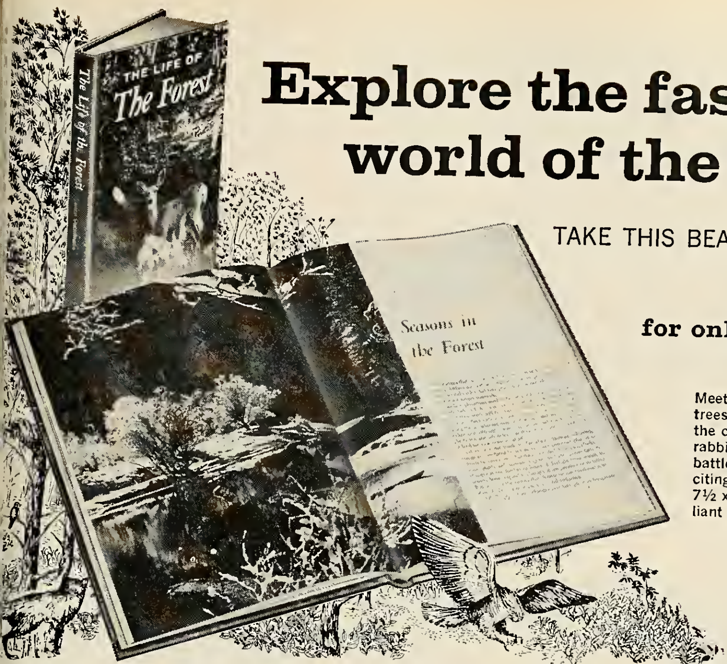
Neither eaten nor fed. this scrawny cow must scavenge for its food.

the possibility that all these needs could be met at a lower energy or monetary cost per peasant household by reducing the number of aged cows that the peasant tolerates in his ménage. To prove that the ecosystem under discussion is essentially adaptive for human life it must be shown that resources consumed by the cows, old and young, do not, from the point of view of the peasant's balance sheet, outweigh the enumerated contributions. This proof is fairly easy to establish.

Note, first of all, that one of the most persistent professional complaints against the sacred cow is that the beasts wander all over the place, cluttering up the markets, railroad stations, and roadsides. Many authorities seem not to inquire why all this wandering takes place from the point of view of the cow, since presumably she has remained uninformed of her sacred privileges. The cow is wandering about because she is hungry and is looking for food—in the ditches, around the base of telegraph poles, between the railroad ties, along the hillsides, in every nook and cranny where something edible has reared its head. The sacred cow is an exploited scavenger, a mere walking skeleton for most of the year precisely because her ecologica niche is removed from that of huma food crops.

An ecological explanation of wh so many cows are kept is now possible: Each farmer needs his ow pair of bullocks. Lacking cash, h cannot afford to buy these animal Rather than risk going into debt a usurious rates, he prefers to try t breed bulls (which he will exchang later for bullocks). Since all th available land is given over to huma food crops, the breeding cows mu scavenge for their food. Being unde nourished, they breed irregularl The farmer refrains from culling u calved animals since they conve grain by-products and scrub veget tion into useful dung. Meanwhil there is always a chance that the co will eventually conceive. If a fema calf is born, the scrub and chaff a converted into milk, while the calf gradually starved to death. In t long run, the more cows an indivi ual farmer owns, the greater t likelihood that he can replace h bullocks without going into debt.

This explanation does not invol references to ahimsa, the Hindu do trine of the sanctity of life. Instea the large number of cows and bu ocks is seen as the result of ecologic pressures generated by the huma population's struggle to maintain



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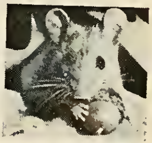

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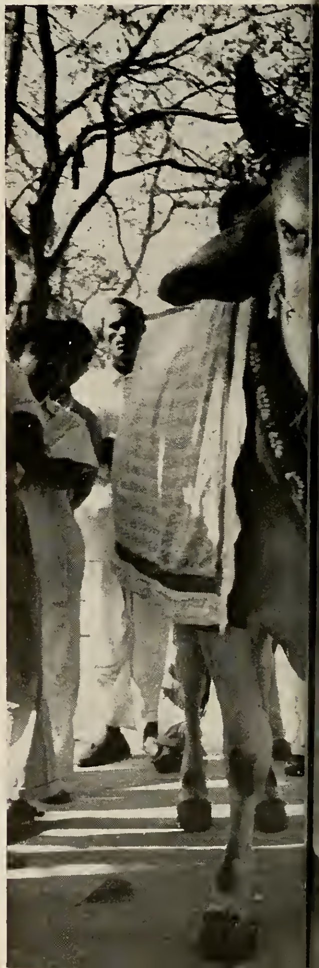
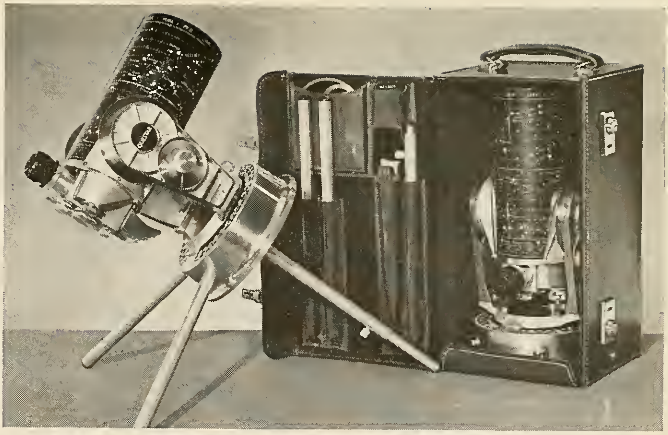
self. Ahimsa may thus be regarded as an ideological expression of these pressures; in other words, ahimsa itself derives power and sustenance from the material rewards it confers upon both men and animals.

In answer to the second question under consideration, it would thus seem that the basic ecology of Indian cattle production is not a mere reflex of the Hindu taboo on slaughter. Removing that taboo might temporarily alter the ecosystem. In the long run, however, the rate at which cattle are presently slaughtered in India is governed by the ability of the peasantry to slaughter them without impairing the production of traction animals, fuel, fertilizer, and milk. It is a well-known fact that the least efficient way to convert solar energy into comestibles is to impose an animal con-



verter between plant and man. Hence, it is wrong to suppose that India could, without major techno-environmental innovations, support any large number of animals whose principal function was to supply animal protein. It has already been shown that the supply of beef is now one of the functions of the cattle complex, but this must necessarily remain a marginal or tertiary attribute of the ecosystem. As a matter of fact, it is obvious that any large-scale drift toward animal slaughter before the traction, fuel, and manure needs of the productive cycle were met would immediately jeopardize the lives of tens of millions of Indians.

The relation of the sacred cow to man in India is symbiotic, not competitive.



QUESTAR RECEIVES A LETTER

July 28, 1966

Questar Corporation
New Hope, Penna.

Gentlemen:

I have now had a fair number of clear good-seeing nights since purchasing the Questar and can furnish you with some detailed observational results I've obtained. All of the planetary observations here mentioned have been forwarded to the Association of Lunar & Planetary Observers (ALPO) of which I am a member. You may quote anything I say here.

Double Stars: Zeta Bootis (1.2 seconds of arc) and the closer component of Nu Scorpii (1.0 second) are both easy at 160x with good seeing. Eta Coronae Borealis, which is now only 0.5 sec., is more difficult, but not as severe a test as I had expected. Based on the above I would say that, given optimum conditions, Questar could detect doubles at 0.4 sec. separation or even less.

Planets: Unfortunately, Jupiter was in poor position in April and May for good viewing as it was only 25° or less above the western horizon. Despite this I saw delicate detail in the NEB-EZ-SEB regions at 160x when Jupiter was only 15° from the horizon. I was not able to follow the detail due to bad weather on other occasions.

Saturn is another story. I have been observing it since early June and the results are amazing. On June 17, only 2 days after the sun passed through the ring plane, I detected the rings! This is truly a feat, since in the Questar light is lost in passing through all the glass elements. On Saturn's disk, detail in the EZ seems almost to merge with the rings where they cross the ball. The space between this detail (very faint) and the ring (very dark across the ball) cannot be more than 0.3 to 0.5 sec. Yet at 200x and 160x Questar separates them. Mr. Hal Metzger, a charter ALPO member with 35 years of planetary observing, required a 6″ f/12.5 and an 8″ f/6 to do this same thing. He was astounded that the Questar did it. My report reached him first and he confirmed every detail. This latter observation took place on July 23, 1966. Both of his telescopes' mirrors are by Joe Frisch. His 4½″ reflector is too.

Moon: I have detected craterlets in Plato (fairly easy) and also Archimedes (more difficult) at 160x. Also I recently delineated Hyginus N, a shallow craterlet north of the well-known Hyginus. I also saw Linné as a small pit standing on a dome.

In stellar observation the 12th-magnitude star following the Ring Nebula is not difficult, and I have penetrated to below 13th magnitude with Questar. My biggest surprise came on Deep-Sky objects. I had expected Questar to give only dim views of them, due to its 3½″ aperture, but instead the superb contrast and very dark field give very vivid views of these objects. We have seen stars resolved right across the center of M13 and M5 at 96x. Bill McHugh saw this too. Of course, the dark sky at my location helps a great deal. The center of M57 is not dark, but pale and nebulous, indicating that we are seeing some of the nebulosity there.

The above are samples from my observing book of the results I have had. I am sure you will be interested in these observations, especially the lunar and planetary ones, because this is my specialty and my eyes are trained for it.

Sincerely yours,
Rodger W. Gordon

QUESTAR NOTES

A Questar is on exhibit at the Hayden Planetarium in the American Museum of Natural History, New York City, in conjunction with the work of Robert T. Little, an amateur astronomer and photographer who takes pictures of a professional quality with his Questar and Nikon camera.

Three cases in the upper hall of the Planetarium contain a display of his beautiful photographs of star clusters and clouds of glowing gas in our galaxy, and of some of our extragalactic neighbors. Included are the Horsehead Nebula and Great Nebula in Orion, the Trifid and Lagoon Nebulae, and the Great Galaxy in Andromeda. These were taken with a special setup, using a Nikon camera and lens and the Questar as a guide 'scope, its drive powered by the Varitrac. Exposures were as long as 45 minutes.

Photographs taken with the telescope, showing fine detail on the moon, are also on display.

The exhibit will continue through June.

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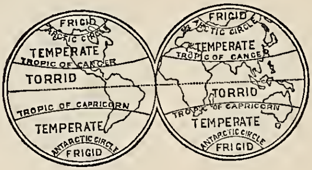

A Naturalist at Large

When people are coming to visit us for the first time, we point out that our house is easily identified because of the red front door and the greenhouse on the side. The door is easily explained. It is the consequence of the actions of a guest, a professor from Stanford University, who had a long-suppressed desire to paint something red—and the door seemed a likely object. The greenhouse is another story.

For years we talked about doing something with the screened porch on the southeast corner of the house. We sometimes used it in the summer, but even then we usually preferred to sit outside in the garden. During most of the year it simply accumulated garden furniture and dust. Finally, in the fall of 1964, with winter not far ahead, we were moved to action. We got hold of a contractor, who did a most elegant job of converting the porch into a conservatory. The screens were replaced with thermopane windows, the old wooden floor was covered with green tiles, fluorescent lights were installed on the ceiling and screened with what I believe is called an "eggshell" grill. We arranged a laboratory-like sink with hot and cold water in one corner and installed an electric heating system.

It was November before everything was in order and we could start to look for plants. I ordered a collection of things from a Florida nursery, but they arrived during a cold spell—all dead. So we got the conventional sorts of plants that are handled by local florists; but we did find that near Detroit we had one

Overseas Nature Tours – 1967 –

For six years we have been organizing group trips to investigate the natural history of Europe, Africa and the rest of the world. Chief purpose so far has been to see birds, including as many rare and difficult species as possible. However, a full ecological picture is sought, with attention to botany, geology and archaeology where appropriate. Here is the program for 1967.

– EUROPE –

MEDITERRANEAN: Height of spring from Por-ugal to Turkey, stressing Mediterranean birds and flowers. April 16; 4 weeks. (See next).

IRON CURTAIN: Little-visited areas of Turkey, Bulgaria, Hungary and Poland, plus Russia from Leningrad to the Black Sea. May 13; 4 weeks.

BRITAIN: Nature highlights of England, Wales and Scotland at peak of bird nesting season. May 27; 3 weeks.

SCANDINAVIA: Thrilling circuit of the Far North: Norway's mountains, fjords and islands; North Cape and the midnight sun; Lapland and Sweden. Two departures—June 18 & 25; 4 wks.

ICELAND: Arctic wildflowers, nesting birds and seabird cliffs against a weird background of volcanoes, geysers and waterfalls. Two departures—June 4 & June 25; 2 weeks. Optional excursion to Greenland after each tour.

– AFRICA –

SOUTH AFRICA: Southwest Africa, Kalahari Desert, Cape of Good Hope, Kruger Park. July 22; 3 weeks. Connects with next.

EAST AFRICA: Rich bird & mammal regions of Kenya, Tanzania, Uganda. Aug. 12; 3 weeks.

– SOUTH AMERICA –

COLOMBIA: Intensive bird observation in the world's top bird country. July 15; 3 weeks.

PERU-ECUADOR: Birds of the upper Amazon and Andes, including Machu Picchu & Bolivia. Aug. 5; 3 weeks, plus optional Galapagos trip.

– AUSTRALASIA –

The following 4 trips connect in sequence, repeating the highly successful South Pacific venture of 1965. Expert local bird leadership.

BIRDS OF MELANESIA: Fiji, New Caledonia, New Hebrides, Solomon Islands and 2 weeks in New Guinea. Sept. 9; 4 weeks.

AUSTRALIA WEST & NORTH: Perth to Darwin and Alice Springs. Oct. 7; 3 weeks.

AUSTRALIA EAST & SOUTH: Barrier Reef, Queensland, southern Australia and Tasmania. Oct. 28; 3 weeks.

NEW ZEALAND: South with the spring from Auckland to Stewart Island, including Mt. Cook and Milford Sound. Nov. 18; 3 weeks, plus op-ional 2-week botany trip up west coast.

– NORTH AMERICA –

TEXAS-MEXICO: Bird highlights of Texas coast nd N.E. Mexico. Mar. 26 (Easter); 2 weeks.

ARIZONA: Richest part of U.S. for rare bird pecies, desert flora. May 13; 2 weeks.

The following 4 tours constitute a connected eries visiting nature highlights of the Pacific oast from Mexico to Alaska, emphasizing Na-onal Parks, Forests & Wildlife Refuges. 2 wks. ach.

SIERRAS, San Diego to San Francisco; June 10. **ASCADES & COAST RANGE**, San Francisco to ancouver; June 24. One-week interval for In-de Passage cruise. **ALASKA**, including Glacier ay, Katmai and Mt. McKinley; July 15. **ALASKA UTPOSTS**, the Arctic Coast east of Barrow, the ribilofs and two spots in the Aleutians; July 29.

– COMING LATER –

ASIA: (1) India & Nepal; (2) Thailand & alaysia; (3) Philippines; winter 1968-69. Also 4) Japan, May 1968. Three weeks each.

AFRICA: (1) No. Africa, Atlas Mtns.; (2) est Africa, Senegal to Angola; (3) Central frica & Madagascar; (4) Ethiopia North. In 968 and 1969; 3 weeks each. Also see above.

SOUTH AMERICA: (1) Chile & Tierra del uego; (2) Argentina; (3) Brazil; (4) Vene-ela, Trinidad & Guianas. . . . Also see above.

MIDDLE AMERICA: Six routes in Mexico, in-ding Yucatan, two in Central America, two in est Indies. Two weeks each; details on request.

NORTH AMERICA: (1) Florida; (2) Newfound-nd & Labrador; (3) Great Basin; (4) Rocky tns.; two weeks each. And in 1969 a retracing the Peterson-Fisher "Wild America" route m New England to Mexico to Alaska.

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of the best orchid nurseries in the country, where we were able to get a nice collection of unusual species.

Winter set in, and I took to spending an increasing amount of time in my "garden," to everyone's great surprise since I had previously shown no interest in cultivated plants, even when living in the tropics. But the place seemed static—it needed animals.

A friend, returning from Mexico, brought us some small lizards, which we turned loose, feeding them on fruit flies and mealworms. For Christmas, another friend gave us a pair of small iguanas, which we promptly named Abélard and Héloïse. Iguanas are vegetarian, so there was no problem in feeding them, although we soon learned that they are incompatible with some kinds of plants in a small room—poinsettias, for instance. The garden was presently reduced to the kinds of plants iguanas don't like to eat; fortunately, this still left a great variety of things, and iguanas can be fed with lettuce, cabbage, bananas, and the like from the market.

But why not some birds? I thought about finches as being small, easily maintained. and unlikely to do much damage to plants. I did nothing about this, however, until I happened to be in New York later in the winter and got a list of animal dealers from friends at the zoo.

My first visit was to a pet shop specializing in rare birds, and they suggested that hummingbirds would do nicely in my garden. I hadn't known you could buy hummingbirds, but it confirmed my suspicion that you can get anything in New York if you know where to look. A graduate student at Michigan, Bob Lasiewski, who had written his thesis on hummingbird physiology, kept his birds in a laboratory across the hall from my office, which made me realize that they could be maintained without too much trouble. So I returned from New York with a pair of Gould's Violet Ear Hummingbirds (*Colibri coruscans*) from the upper Amazon and a pair of honeycreepers (*Cyanerpes caeruleus*) from Costa Rica—as well as a pair of cotton-topped marmosets and assorted lizards and frogs. The household has not been the same since.

That glassed-in room with the hummingbirds and the honeycreep-

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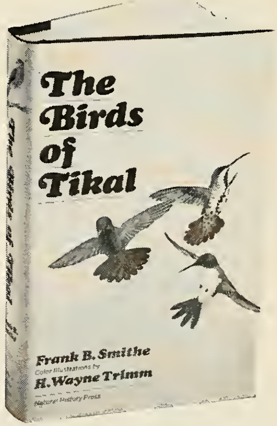

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ers (we had to keep the marmosets in a cage) was marvelous fun—but obviously too limited a space. As soon as weather permitted construction, we added thirty feet of greenhouse along the side of the house. Lots more plants, lots more birds—a bit of the tropics in Ann Arbor. I had my "experimental rain forest." The problem became how to keep out of it and get anything else done.

We have made many mistakes and —I hope—learned something about the management of plants and animals. The experience obviously deserves a book and, as usual, I have the title first: *A Jungle in the House.* In the beginning I really thought I could have a little sample of rain forest, with monkeys, birds, lizards, frogs, and various insects happily mixed together in the trees. But this didn't work: monkeys catch birds and wreck plants simply by climbing over them; birds are quite unpredictable as to what they are likely to tear up in search of nesting materials; small lizards make fine monkey food and also manage to escape through very narrow openings.

The place is now divided into three compartments. The original porch is the Orchid Room, although most of the orchids have been moved out to be replaced by a variety of shade-tolerant plants, along with hummingbirds, honeycreepers, lizards, and tree frogs. Ten feet of the greenhouse is partitioned off to form the Monkey Room, where the marmosets live with plants they can't injure, and the iguanas with plants they won't eat. The remainder of the greenhouse forms the Mango Room, named for a flourishing tree from which I hope presently to gather some of my favorite fruit. The vertebrate fauna there consists entirely of small birds: tanagers, some finches, and a pair of Long-tailed Blue-backed Manakins, along with assorted hummingbirds. The problem is to resist temptation and not overcrowd the place.

The hummingbirds remain my favorites. I now have seven species, and there is an endless fascination in sitting in the room with them and watching what they do. They are easy enough to keep except that they require attention twice daily, since they cannot go without food for any length of time. For daytime feeding I use a formula worked out by Lasiewski: brown sugar, 1 cup; Mellin's Food, 1 tablespoon; Gevral Protein, the same; evaporated milk, 2 tablespoons; multiple vitamins, 16 drops; dicalcium phosphate, 2 capsules; water to make 1 quart. The feeding tubes are washed thoroughly in the late afternoon, and filled with one part sugar to three parts water for the night.

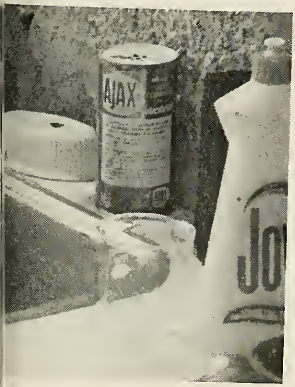
People often ask if I feed honey to the hummingbirds. The answer is no. Dr. Augusto Ruschi of Brazil, who has had more experience than anyone else with hummingbirds in captivity, found that honey is liable to promote a fatal fungus growth on the birds' tongues. People who try to attract hummingbirds to their gardens with honey solutions may thus really be causing damage. John Vosburgh has described the details on this in his column, "The Editorial Trail," in the issue of *Audubon Magazine* for September-October, 1965.

Hummingbirds in the wild also eat many small insects, and zoos and people with aviaries try to keep them supplied with fruit flies. I remember vividly my first experience with this: I had been growing fruit flies in the Orchid Room for the lizards, and when I first introduced the pair of Gould's Violet Ears, the birds cleaned up the flies so rapidly that the lizards starved to death. I now grow large numbers of flies in all of the rooms in boxes of rotting fruit under the benches. Fruit left over by the tanagers, honeycreepers, and manakins goes into the boxes, and the corner grocer gives me all of the fruit that goes bad on him. The flies of course, get all through the house to some extent, and anyone having wine or a drink with fruit juice is liabl

to find a few in his glass. But this seems a minor inconvenience.

It is great fun to watch the different species bathe. A sabrewing (*Campylopterus villaviscensio*) in the Mango Room has the habit of sitting on a wire under the light, where we can watch him as we eat dinner, catching the fruit flies that are attracted there. At intervals he takes off to dive into the clear water of a small fountain, going completely under for an instant, and then flying back to the wire to shake out his feathers. The Rivoli's Hummingbirds (*Eugènes fulgens*) usually prefer to slither down the wet leaves of banana plants under a mist nozzle, or sometimes simply to fly in and out of the rainlike mist.

In the Orchid Room, where the laboratory sink is, the Blue-throats (*Lampornis clemenciae*) like to dodge about under a drizzle from the faucet. I put a flowerpot upside down with a sponge on it under the dribble for their convenience. Brunhilde, a most independent-minded Bluethroat (all the birds have personal names), will frequently buzz me while I am working there until I stop and set things up for her bath. The honeycreepers like this arrangement too, and there is often some competition. I have fixed a small fountain in the room with one of those circuating electric pumps, which seems to ne a perfect place for bathing. I have een the birds try it sometimes, but t is clear that they have a very definite preference for the sink. They ave no esthetic sense at all—prefering electric wires to branches, and inks to fountains. It is hard, when ou have a jungle in the house, not be anthropomorphic.



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DAWN RENDEZVOUS ON THE LEK

Aggression, territorial defense, and sexual attraction are central elements in the communal display ceremonies that several kinds of birds perform

BY PAUL A. JOHNSGARD

In its classic sense, "lek" refers to
he traditional assembly ground or
lisplay area on which groups of Eu-
opean Black Grouse, *Lyrurus tetrix*,
nales congregate in the spring and
all to defend territories and to at-
ract female grouse. In such leks
rom five to twenty-five males typi-
ally gather at dawn, each on its own
mall plot within the shared lek, to
ıreaten one another with aggressive
ostures and to call and strut before
ıe females. Unlike typical avian ter-
itories, there is no nesting on the
k and little foraging; rather, the
rea is used almost exclusively for
eproductive purposes. The word lek,
ı fact, is believed to have derived
om the Swedish *leka,* which means
to play," but which also carries sex-
al connotations.

Of the seventeen other grouse
ecies in the world, four North
merican species display socially in
assic lek fashion. Species of eleven
her bird families also perform com-
unally in recognizable, restricted
ırenas," including numerous tropi-
l American manakins and various
ew Guinea birds of paradise. Aus-
alian bowerbirds perform similar
remonies, but in larger arenas
here the individuals are more wide-
separated. Some forest-dwelling
ouse, such as the North American
ue Grouse, *Dendragapus obscurus,*
d the European Capercaillie, *Tet-*
o urogallus, also usually display in
xploded" leks where the males may
out of sight of each other but with-
hearing range. Such situations,
ıere individual males are far apart,
ade imperceptibly into typical ter-
orial behavior.

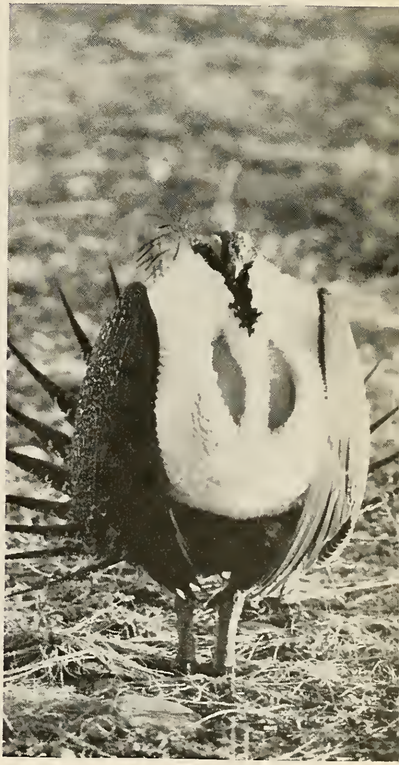
Wherever classic lek ceremonies
ve evolved, they are associated
th certain other behavioral corre-
es. In all true lek species, the
nale performs incubation and rear-
duties; lek behavior is therefore
be expected only among those
ecies in which the female alone is
e to protect and rear the young.
e males are always polygamous or
miscuous in their mating, and a
ısiderable degree of sexual di-
rphism—differences between the sexes—exists in structure, plumage, and behavior. Thus, the males of lek species are often brightly colored and perform elaborate visual displays. These are frequently associated with vocal or mechanical methods of sound production. Indeed, some of the most remarkable plumages and displays known are found in birds that participate in lek displays.

Several basic and still partly unsolved biological problems are posed by lek-forming species: What ecological situations favor the evolution of lek behavior in polygamous or promiscuous birds? Why do males of lek species often appear to perform in an identical and synchronized manner, when they are clearly sexual rivals? Do females exhibit any "choice" among the males when the grounds are visited for mating purposes, and, if so, are certain males regularly favored by females? Since the males appear to perform the same displays in exactly the same way, can sexual selection account for the evolution of their remarkable plumages and displays? Finally, how are the dangers of predation reduced or avoided by such vocally and visually conspicuous congregations of displaying birds?

As mentioned, four species of North American grouse perform in typical lek fashion: these include the Greater and Lesser Prairie Chickens (*Tympanuchus cupido* and *T. pallidicinctus*), the Sharp-tailed Grouse (*Pedioecetes phasianellus*), and the Sage Grouse (*Centrocercus urophasianus*). These species differ in appearance from the Black Grouse in a few respects. For example, excepting the Sage Grouse, relatively little plumage dimorphism exists in the North American forms. But, unlike the brushlands and woodland-edge habitat of Black Grouse, all four species are more open-country birds, and it might be expected that the males would retain a female-like, concealing coloration pattern that blends well with grasses and low shrubs. On the other hand, males of all four species compensate for their lack of conspicuous plumage by having hidden air sacs in the neck region. These are unfeathered areas of skin that expand when the esophagus is inflated with air, thus exposing the colored skin and simultaneously producing distinctive sounds in the different species. The relatively weak sounds are supplemented by louder notes and cackles, and by sounds produced by stamping the feet, rattling the tail feathers, or scraping the wings against the breast feathers.

In all four species the males congregate on their leks primarily in the spring, but they also are active to a lesser degree during the fall and at other times as well. On their respective "booming," "gobbling," "dancing," or "strutting" ground, male Greater and Lesser Prairie Chickens, Sharp-tails, and Sage Grouse establish and daily defend their territories, which are often only from 5 to 100 square yards in size. The leks are always in relatively open vegetation

rtly after sunrise, two Greater
irie Chicken males threaten one
ther at the edge of their respective
itories. A third male walks by.



As they strut about, Sage Grouse males erect their tail feathers and periodically inflate and deflate their two esophageal air sacs.

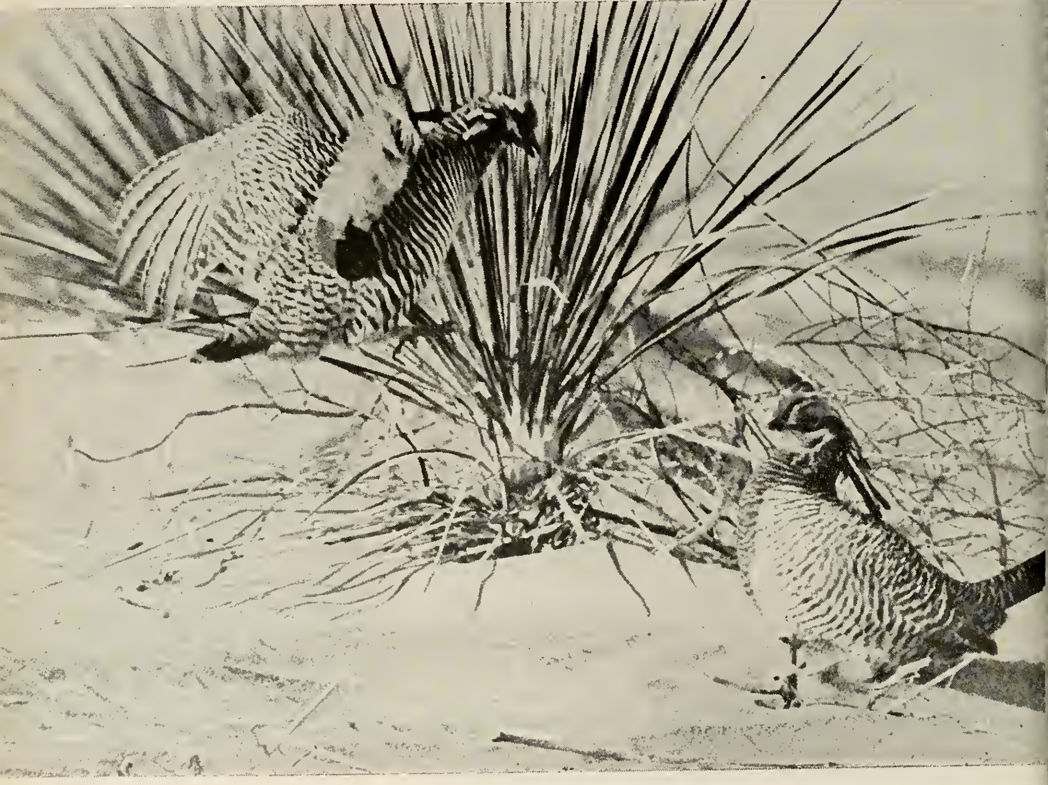
and in many cases are located on elevations where visibility is unrestricted in all directions. Most display activity occurs near dawn and again at dusk, when the light is barely adequate for vision but when few diurnal predators are active.

The number of males on a particular lek varies among species and with population density. In Greater Prairie Chickens from seven to ten males are commonly present, but occasionally there are as many as 40. In Lesser Prairie Chickens the average number appears to be somewhat higher, but 40 males are also apparently about maximum. Sharp-tailed Grouse frequently average seven to ten males, but rarely, if ever, reach 30. In these three species leks are usually no more than a mile apart in good habitat and may be considerably closer when populations are dense. In the larger Sage Grouse, strutting ground densities of about one per five square miles have been reported in Wyoming, and they are usually well over a mile apart. The number of participating males is greatly variable, from as few as six to several hundred, and perhaps averaging between 60 and 80. Some Sage Grouse grounds containing from 400 to 800 males have been reported; such enormous congregations represent multiple leks within which as many as four or five centers of mating activity may occur.

A remarkable feature of these assemblages is the presence of master cocks—dominant males that occupy central positions and often maintain larger than average territories. This situation was first reported for Sage Grouse, but it is also present to varying degrees in Prairie Chickens Sharp-tailed Grouse, and Black Grouse. At the peak of the breeding season, such master cocks are often surrounded by receptive females and are normally responsible for performing the majority of matings on an individual lek. I have observed a Sage Grouse master cock complet seven matings in a presunrise period of 33 minutes, while none were ever attempted by more than 60 other males on the strutting ground. Each female that had been successfully mated left the strutting ground within a few minutes, and only a few females remained after the sun had risen above the horizon. One or more major rivals, or subcocks, are often present, and a larger number of adjacent guard cocks may also participate in a few matings; however, few if any, matings are performed by the numerous peripheral males.

In the Black Grouse a definite correlation between this social hierarch

A high, vertical jump is one of the acts in the aggression display repertoire of these Lesser Prairie Chicken males.



The bright-red combs of skin above the eyes of European Black Grouse males function prominently in their sexual display.

Blue Bird of Paradise engages in perhaps the most bizarre display among birds by hanging upside down from a branch and singing.

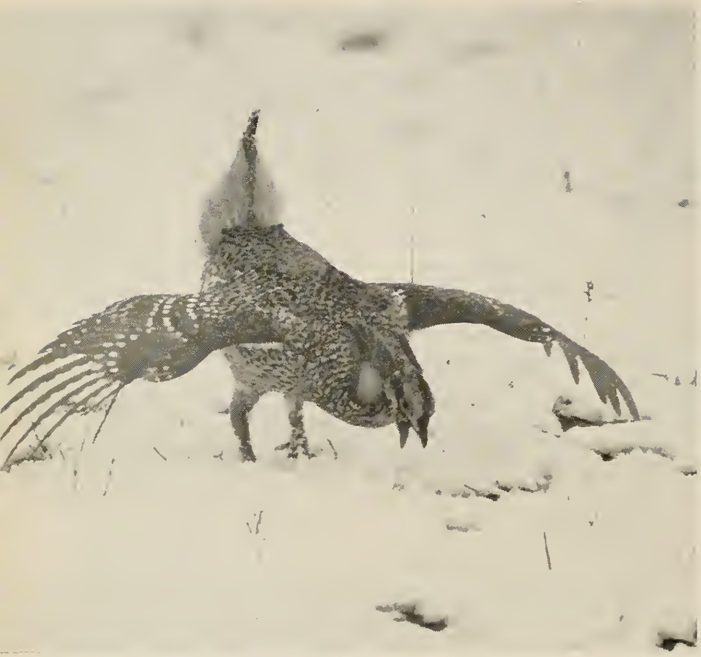
and age has been found: dominant males are three years old or older, econd-rank males are two years old. and males holding peripheral terriories are yearlings. Whether females are selectively attracted for their matng to specific master cocks or are only attracted to the center of the ek is still a debatable point. In any ase, it is clear that whatever their exual attraction value, male displays n grouse are largely aggressive in unction, and they are primarily reated to establishing and preserving erritorial status.

Only a few grouse displays are pecifically reserved for females. hese include the "nuptial bow," which is typical of both species of rairie Chickens and Sharp-tailed rouse. In these same species a short, early vertical flight, or "flutter jump," also occurs and apparently erves to advertise the male's terriory to females. Both the Prairie hickens and the Sharp-tailed Grouse ave calls that are uttered only when emales are on the lek. In Prairie hickens this call is called the whoop," and in Sharp-tailed Grouse e corresponding call is called the bow." Recordings or imitations of ese calls will usually stimulate several males to begin flutter jumping.

Even though most grouse displays probably are primarily concerned with territorial establishment and maintenance, and thus are essentially aggressive in context, relatively little actual fighting occurs in these species. Rather, overt fighting is largely replaced by ritualized fighting, which occurs at the edges of territories and occupies much of each male's time and energy while on the lek. In ritualized fighting, incomplete attacks, feints, and prolonged glaring at the opponent greatly reduce actual combat when birds are claiming and defending their territorial boundaries.

In each of the four species a high degree of species-specificity in male displays and vocalizations occurs, suggesting that the prevention of interspecific hybridization may have been a major factor in the evolution of these display differences. For example, in many respects the plumages and displays of Greater Prairie Chickens and Sharp-tailed Grouse are direct opposites, suggesting that they could readily serve in maintaining reproductive isolation. The Greater Prairie Chicken has a brown, rounded tail, yellow air sacs, and erectile pinnae on the neck. Sharp-tailed Grouse have more grayish, pointed tails, purple air sacs, and lack pinnae. Sharp-tailed Grouse "dance" forward in an erratic pattern while rattling their tail feathers; Prairie Chickens similarly stamp their feet while remaining in a stationary position and alternately spread and snap shut their tail feathers. Yet, where man's activities have brought these two once relatively isolated species into contact, hybridization has repeatedly occurred, indicating that these structural and behavioral differences are not completely effective in maintaining reproductive isolation. This fact—and the general absence of original overlap between the species of lek grouse in most areas—suggests that sexual selection or other factors have been of primary importance in the evolution of these patterns. Additionally, the species most thoroughly ecologically isolated from the others, the Sage Grouse, has the most distinctive male plumage and the most remarkable displays of all.

The Sage Grouse is reported to be anatomically distinctive from the other lek grouse, and some ornithologists have suggested that perhaps it is actually a forest grouse that became adapted to a sagebrush habitat and evolved a lek display and plumage pattern having convergent similarities to those of the typical prairie grouse. It is true that there appear to be no flutter jumping, dancing, or

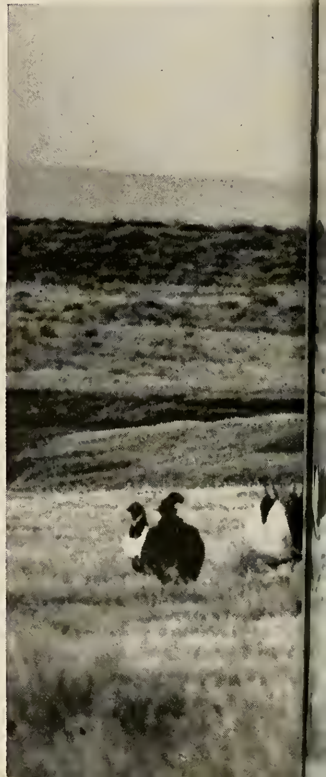


A wing-spreading bow, accompanied by the sounds of shaking tail feathers, is an element of the courting dance of Sharp-tailed Grouse males.

bowing displays in Sage Grouse, and the air sac locations and rates of inflation are altogether different. But some of these behavioral divergences may be related to bodily size differences, ecological effects, or other indirect factors. Since it is reasonable that an extreme behavioral and structural sexual dimorphism in Sage Grouse might be expected to have developed through the intensive sexual selection associated with large average lek sizes and a rigid social hierarchy dominated by a single master cock, these differences in the Sage Grouse may have little or no significance. However, it does appear that lek behavior in grouse is more likely to evolve in open-country than in forest-dwelling species, which usually are relatively solitary and perform their noisy displays from logs or branches in trees. In leks of the forest-dwelling manakins and certain birds of paradise, the males usually display in the upper levels of the trees or in cleared areas near the forest floor where sunlight penetrates the leafy canopy.

Males of each of the grouse species use the visual signals and sounds produced by air sac inflation as a major species-specific display. In Greater Prairie Chickens this "booming" is accompanied by a soft, three-part cooing note and an enormous extension of the yellow air sacs. In the Lesser Prairie Chicken a repeated "gobble" is uttered, and the inflated air sacs are crimson colored. A soft, sometimes repeated "cooing" or "hooting" sound is uttered frequently by Sharp-tailed Grouse, but their purple air sacs are not greatly inflated. Finally, the Sage Grouse rapidly inflates and deflates its frontal, greenish-yellow air sacs several times in succession, producing strange plopping sounds as the bird struts about with its tail strongly cocked and spread. The cooing of Sharp-tailed Grouse is subordinated in importance and frequency to a tail-rattling display that is performed in conjunction with dancing. In this unique performance a rapid, lateral shaking of the tail produces a series of clicking sounds at a rate reported to be almost 50 per second, caused by the inner webs of the tail feathers rubbing over the adjacent feather shafts. An equally unusual sound is produced by the Sage Grouse during its strutting, by the repeated rubbing of the folded wings downward and forward over the stiffened, white "cape" feathers of its breast.

The collective noisy activities of the congregated males on leks may have several effects. First, it obviously attracts mature females and possibly stimulates their endocrine glands to bring them into final reproductive readiness for ovulation. When such females visit the lek they are given attention by many males but usually congregate about the master cock. Probably a female visits the lek for several mornings prior to, and during the period of, laying, but

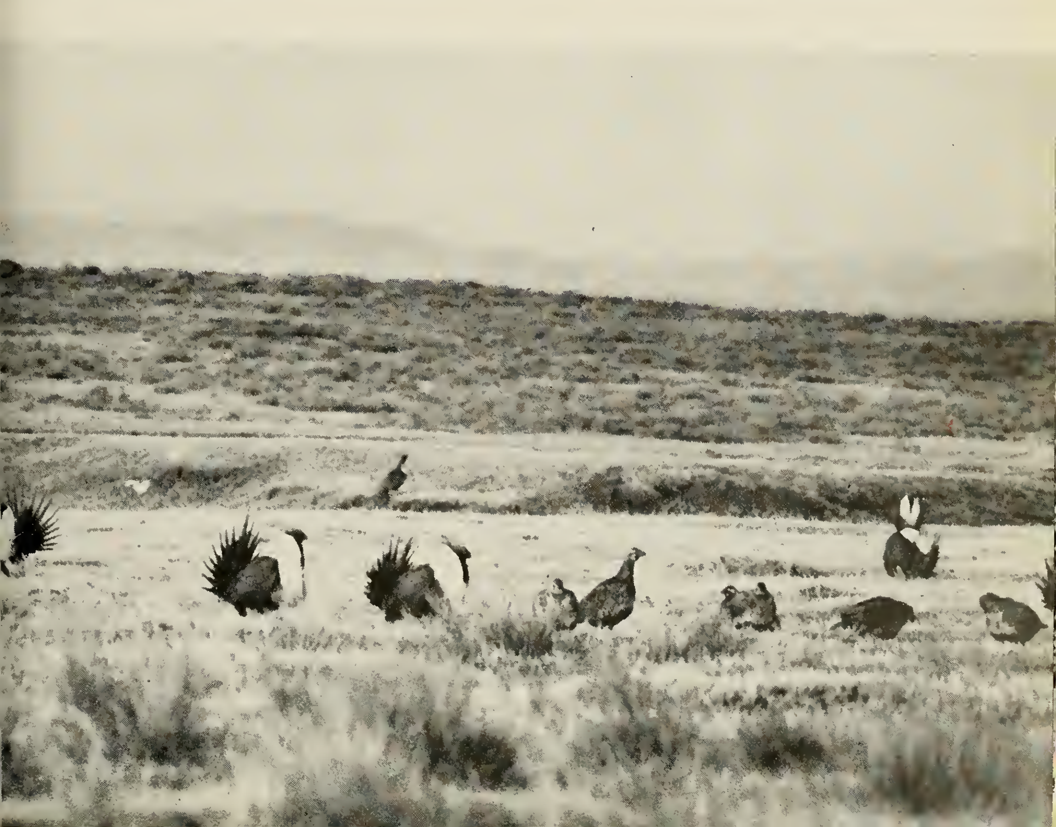


A rigid male hierarchy prevails on Sage Grouse leks. The dominant male is at center right facing a group of receptive females.

s point is still unproved. A second obable effect of the displaying les is to attract predators. Presumly a "safety in numbers" concept plies here—at least some of the ny males are likely to observe a ssible predator whereas a single playing bird might not. In Sharpled Grouse there is a remarkable chronization of dancing on the t of the males, which alternately ce in concert and stop motionless nearly perfect synchrony. During ting periods the birds appear to very attentive to extraneous noises movements. In all species, a flying vk or other suspicious movement l cause a total cessation of display ivity and a possible mass flight y from the lek area.

e advantages of lek display in miscuous species would thus apr to be several. Obviously, it proes for an efficient perpetuation of species through allowing reprotion by only the males that are ciently strong and virile to maintain their status as master cocks. However, the aggregations of numerous displaying males may perhaps provide greater attraction value and hormonal stimulation to females than would lone displaying birds. Although peripheral males are excluded from mating and do not benefit from participating in social display, the "apprentice" period they serve on the outer limits of the lek may better prepare them to hold central territories in later years. Furthermore, the peripheral males perhaps constitute a buffer of expendable individuals that could be lost to predators without reducing the population's reproductive efficiency. It has been recently suggested that lek aggregations also may have a population dispersion effect and might thus fulfill the spacing function of more typical territories, and that leks may function as a density-regulating mechanism through their control of reproductive success in the population. However, this last point does not yet appear to have been fully demonstrated.

Whatever the primary and secondary functions of lek behavior, it is pleasant to contemplate that all four species of the American lek grouse can still be observed and studied in various parts of the United States. Sadly, all of the species have greatly suffered from the effects of land-use changes in the last several decades, and it is possible that one or more of them will ultimately go the way of the Heath Hen, the extinct eastern form of the Prairie Chicken. Preservation of fairly large areas of natural grasslands will probably be the only way to save the midwestern and Gulf Coast races of the Greater Prairie Chicken, which today are rapidly declining in numbers and diminishing in breeding ranges. As any person can testify who has known the pleasure of huddling in a blind during the predawn beauty of a clear spring morning, while listening to the weird sounds outside and waiting for the sun to illuminate the shadowy figures, the extinction of any of our lek grouse would be an irreparable loss to the American bird fauna.



Photographs from *Surtsey* by Sigurdur Thorarinsson.
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surtsey

n Island Emerges • by Julian Kane

Heavily laden with dark volcanic ash,
an eruption column spews violently skyward
from the lips of one of Surtsey's vents.

By January, two months after eruptions began,
the island's altitude reached 670 feet.
Snow powders the crater's outer slopes.

In the early morning of November 14, 196
Icelandic fishermen sailing near Vestmannaeyj
(Westman Islands), about twenty miles south
the Iceland coast, first noticed a strong sulph
smell in the air and then saw tremendous, loomi
clouds of gases and ejected volcanic fragments ri
ing from the sea. Their boat rolled irregularly; a
engineer measured the ocean temperature a
found it 9 Fahrenheit degrees higher than norma
A new island—subsequently named Surtsey, aft
the mythical Norse giant that came with fire
Iceland—was in the process of birth and wou
emerge from the sea the following night. With
six weeks, continuous explosions of ash, cinde
and pumice had built up a cone that rose 500 fe
above sea level, and high, roiling volcanic clou
could be seen from the Icelandic capital, Rey
javik, 75 miles away.

Spectacular thunderstorms, lightning displa
and tornadoes formed and re-formed over the
land during this explosive stage of Surtsey's eru
tion. The thunder and lightning indicated t
potent electrical properties of volcanic clou
Tornadoes resulted from rapidly rising ash pa
ticles caught in violently expanding updrafts

Billows of steam rise, as rivulets of glowing la
reach down to the cold waters of the North Atlant

Its outer surface congealing in the cool air, a new lava flow crawls slowly over a layer of previously solidified lava.

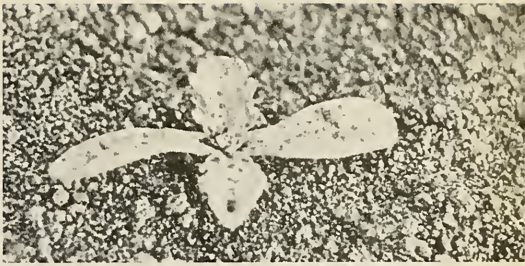
escaping gases, whose temperatures, as measured by Icelandic scientists, exceeded 2,000°F.

Five months after the birth of the island, the continuing eruptions quieted and entered a lava-flow stage, which covered the easily eroded cinders with successive layers of durable basalt and scoria (porous lava). With the termination of the violent explosive stage, the tornado features also ceased. By then Surtsey had grown to nearly a square mile in area, with about an acre of new land being formed daily by the almost continuous lava flows.

Late one evening in the summer of 1964 I flew over the island in a small plane to look at the eruptions. As we approached the volcano, rising gray clouds of smoke and ashes floated downwind of the crater in trailing, eddying plumes. Black ashes were falling on the slopes and into the sea on the eeward side. Every minute or so, bright-red fountains of lava shot up dozens of feet above the crater and either dropped into the maw or were blown out of the crater by the stiff sea winds, falling as darkened, glowing fragments that tumbled down the black slopes. A break in the wall of the crater enabled several steady streams of molten ava to twine their way down to the sea. Where he various lava streams met the water, huge white clouds of steam formed and were blown for miles downwind of the island.

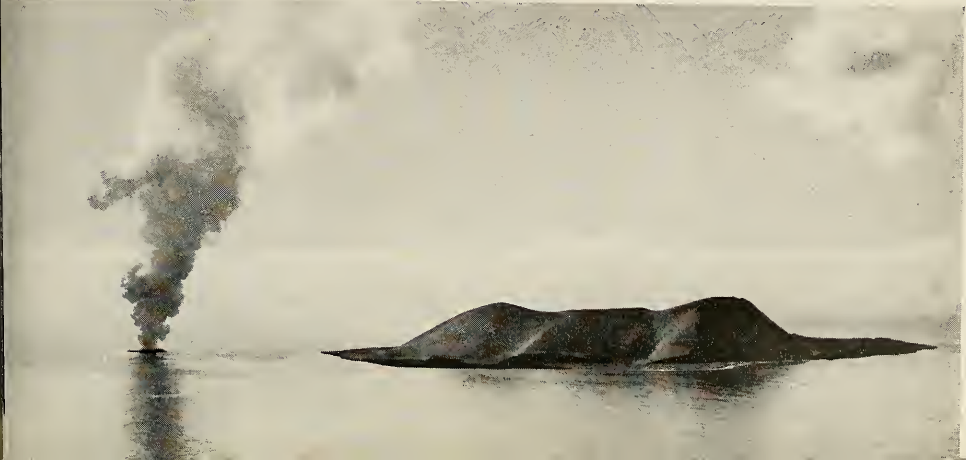
Lava ceased flowing seaward on May 17, 1965. But on May 25, a column of volcanic steam rose rom a submarine eruption a third of a mile east of Surtsey—a new island was forming from an extension of the Surtsey eruption. Magma that had previously moved out through vents on Surtsey had now found a less resistant path to the surface. But Syrtlingur, the new island, which by September had grown to an area of about 35 acres, disappeared shortly after eruptions ceased. Wind and wave erosion, intensified by severe autumn weather, undoubtedly accounted for its demise.

In all probability, Surtsey will be a permanent island. In the spring of 1965, an international symposium of scientists gathered in Reykjavik and recommended that travel to the island be restricted as much as possible to researchers. Surtsey was, accordingly, declared a sanctuary. Botanists, zoologists, and other biologists are now studiously watching life develop on this new volcanic island.

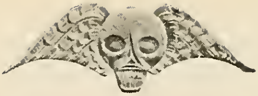


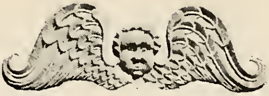
The sea-rocket, Cakile edentula, *was the first green vesicular plant on Surtsey, taking root more than a year and a half after the island formed. Ocean currents had probably transported the seeds.*

As Surtsey lies dormant, eruptions to the east begin to form Syrtlingur, an island that eroded completely away after five months.



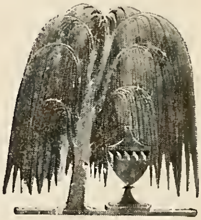
Death's Head





Cherub

Urn and Willow



By James Deetz

& Edwin S. Dethlefsen

An unusual kind of archeological detective work yields new insights into the spread of culture through colonial New England. It also tests the science of archeology for accuracy

Enter almost any cemetery in eastern Massachusetts that was in use during the seventeenth and eighteenth centuries. Inspect the stones and the designs carved at their tops, and you will discover that three motifs are present. These motifs have distinctive periods of popularity, each replacing the other in a sequence that is repeated time and time again in all cemeteries between Worcester and the Atlantic, and from New Hampshire to Cape Cod.

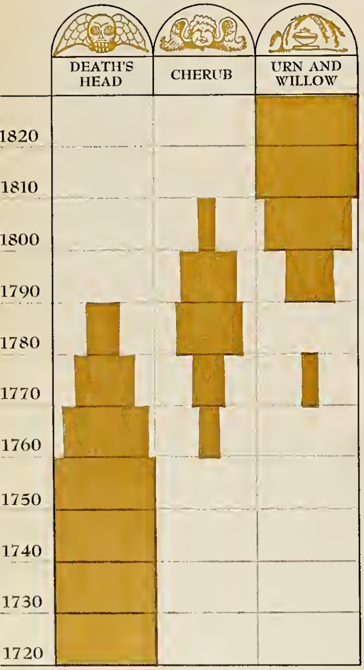
The earliest of the three is a winged death's head, with blank eyes and a grinning visage. Earlier versions are quite ornate, but as time passes, they become less elaborate. Sometime during the eighteenth century—the time varies according to location—the grim death's head designs are replaced, more or less quickly, by winged cherubs. This design also goes through a gradual simplification of form with time. By the late 1700's or early 1800's, again depending on where you are observing, the cherubs are replaced by stones decorated with a willow tree overhanging a pedestaled urn. If the cemetery you are visiting is in a rural area, the chances are quite good that you will also find other designs, which may even completely replace one or more of the three primary designs at certain periods. If you were to search cemeteries in the same area, you would find that these other designs have a much more local distribution. In and around Boston, however, only the three primary designs would be present.

If you were to prepare a graph showing how the designs change in popularity through time, the finished product might look something like three battleships viewed from above, the lower one with the bow showing, the center one in full view, and the third visible only in the stern. This shape, frequently called a "battleship-shaped" curve, is thought by archeologists to typify the popularity career of any cultural trait across time. Prepared from controlled data taken from the Stoneham cemetery, north of Boston, where the style sequence is typical of the area around this eighteenth-century urban center of eastern Massachusetts, the graph below shows such a curve.

It is appropriate here to interrupt and pose the question: why would an archeologist study gravestones from a historic period?

Whether archeology can be considered a science in the strict sense of the word is much debated. One of the hallmarks of scientific method is the use of controls in experimentation that enable the investigator to calibrate his results. Since archeology deals largely with the unrecorded past, the problem of rigorous control is a difficult one. Much of modern archeological method and theory has been developed in contexts that lack the necessary controls for precise checking of accuracy and predictive value. For this reason, any set of archeological data in which such controls are available is potentially of great importance to the development and testing of explanatory models, which can then be used in uncontrolled contexts.

Stylistic Sequence from a Cemetery in Stoneham, Massachusetts



For a number of reasons, colonial New England grave markers may be unique in providing the archeologist with a laboratory situation in which to measure cultural change in time and space and relate such measurements to the main body of archeological method. All archeological data—artifacts, structures, sites—can be said to possess three inherent dimensions. A clay pot, for example, has a location in *space*. Its date of manufacture and use is fixed in *time*, and it has certain physical attributes of *form*. In a sense, much of archeological method is concerned with the nature and causes of variation along these dimensions, as shown by excavated remains of past cultures.

The spatial aspect of gravestones is constant. We know from historical sources that nearly all of the stones in New England cemeteries of this period were produced locally, probably no more than fifteen or twenty miles away; an insignificant number of them came from long distances. This pattern is so reliable that it is possible to detect those few stones in every cemetery that were made at a more remote town. Once placed over the dead, the stones were unlikely to have been moved, except perhaps within the cemetery limits.

Needless to say, the dimension of time is neatly and tightly controlled. Every stone bears the date of death of the individual whose grave it marks, and most stones were erected shortly after death. Like the spatial regularity, this temporal precision makes it possible to single out most of the stones that were erected at some later date.

Control over the formal dimension of gravestone data derives from our knowledge of the carvers, who, in many instances, are known by name and period of production, and who, even if anonymous, can be identified by their product with the help of spatial and temporal control. Thus, in most cases stones of similar type can be seen to be the product of a single person, and they reflect his ideas regarding their proper form.

Furthermore, it is known that the carvers of the stones were not full-time specialists, but rather workers at other trades who made stones for the immediate population as they were needed. We are dealing, then, with "folk" products, as is often the case in prehistoric archeology.

Other cultural dimensions can also be controlled in the gravestone data with equal precision, and with the addition of these, the full power of these artifacts as controls becomes apparent: probate research often tells the price of individual stones; status indication occurs frequently on the stones, as well as the age of each individual. Since death is related to religion, formal variations in the written material can be analyzed to see how they reflect religious variations. Epitaphs provide a unique literary and psychological dimension. Spatial distributions can be measured against political divisions. In short, the full historical background of the seventeenth, eighteenth, and nineteenth centuries permits both primary and secondary control of the material, and with the resulting precision, explanations become quite reliable.

With such controls available to the archeologist, the pattern of change in colonial gravestone design and style can be used with great effect to sharpen our understanding of cultural process in general.

To return to the battleship-shaped curves to the left, what does this mean in terms of culture change? Why should death's heads be popular at all, and what cultural factors were responsible for their disappearance and the subsequent rise of the cherub design? The most obvious answer is found in the ecclesiastical history of New England. The period of decline of death's heads coincides with the decline of orthodox Puritanism. In the late seventeenth century, Puritanism was universal in the area, and so were death's head gravestones. The early part of the eighteenth century saw the beginnings of change in orthodoxy, culminating in the great awakenings of the mid-century. In his recent, excellent book on the symbolism of New England gravestones, *Graven Images*, Allan Ludwig points out that the "iconophobic" Puritans found the carving of gravestones a compromise. While the use of cherubs might have verged on heresy, since they are heavenly beings whose portrayal might lead to idolatry, the use of a more mortal and neutral symbol—a death's head—would have served as a graphic reminder of death and resurrection.

Given the more liberal views concerning symbolism and personal involvement preached by Jonathan Edwards and others later in the eighteenth century, the idolatrous and heretical aspects of cherubs would have been more fitting to express the sentiment of the period.

It is at this point that available literary controls become valuable. Each stone begins by describing the state of the deceased: "Here lies" or "Here lies buried" being typical early examples. Slowly these are replaced by "Here lies [buried] the body [corruptible; what was mortal] of." This slightly, but significantly, different statement might well reflect a more explicit tendency to stress that only a part of the deceased remains, while the soul, the incorruptible or immortal portion, has gone to its eternal reward. Cherubs reflect a stress on resurrection, while death's heads emphasize the mortality of man. The epitaphs that appear on the bottoms of many stones also add credence to this explanation of change in form over time. Early epitaphs, with death's head designs, stress either decay and life's brevity:

My Youthful mates both small
and great
Come here and you may see
An awful sight, which is a type
of which you soon must be

or a Calvinistic emphasis on hard work and exemplary behavior on the part of the predestined:

He was a useful man in his generation, a lover of learning, a faithful servant of Harvard College above forty years.

On the other hand, epitaphs with cherub stones tend to stress resurrection and later heavenly reward:

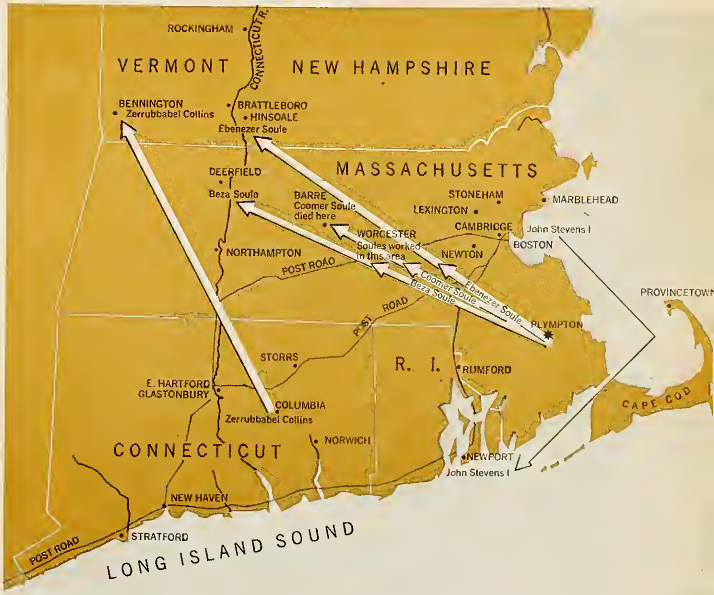
Here cease thy tears, suppress thy
fruitless mourn
his soul—the immortal part—has
upward flown
On wings he soars his rapid way
To yon bright regions of eternal
day.

The final change seen in gravestone style is the radical shift to the urn and willow design. It is usually accompanied by a change in stone shape; while earlier stones have a round-shouldered outline, the later stones have square shoulders. "Here lies the body of" is replaced by "In memory of" or "Sacred to the memory of," quite different from all earlier forms. The earlier stones are markers, designating the location of the deceased or at least a portion of him. In contrast, "In memory of" is simply a memorial statement, and stones of this later type could logically be erected elsewhere and still make sense. In fact, many of the late urn and willow stones are cenotaphs, erected to commemorate those actually buried elsewhere, as far away as Africa, Batavia, and in one case—in the Kingston, Massachusetts, cemetery—"drowned at sea, lat. 39 degrees N., long. 70 degrees W." The cultural changes that accompany the shift to urn and willow designs are seen in the rise of less emotional, more intellectual religions, such as Unitarianism and Methodism. Epitaphs change with design and in the early nineteenth century tend more to sentiment combined with eulogy.

This sequence of change did not occur in a vacuum, unrelated to any cultural change elsewhere; indeed, the sequence of three major types also takes place in England, the cultural parent of the Massachusetts colony, but about a half century earlier. Thus cherubs have become modal by the beginning of the Georgian period (1715), and urns and willows make their appearance, as a part of the neoclassical tradition, in the 1760's. In fact, the entire urn and willow pattern is a part of the larger Greek Revival, which might explain the squared shoulders on the stones—a severer classical outline.

Thus far we have been discussing formal change through time, and some of the fundamental causes. We have seen that New England is changing in harmony with England, with an expectable time interval separating the sequences. But we have not identified the relationship of all of this to archeological method.

The battleship-shaped curve assumption is basic to many considerations of culture process in general and to such dating methods as seriation. Seriation is a method whereby archeological sites are arranged in relative chronological order based on the popularity of the different types of artifacts found in them. The approach assumes that any cultural


ROCKINGHAM
CONNECTICUT R.
VERMONT
NEW HAMPSHIRE
BENNINGTON
Zerrubbabel Collins
BRATTLEBORO
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DEERFIELD
Beza Soule
MASSACHUSETTS
BARRE
Coomer Soule
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STONEHAM
LEXINGTON
MARBLEHEAD
CAMBRIDGE
John Stevens I
BOSTON
WORCESTER
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NEWTON
NORTHAMPTON
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R. I.
RUMFORD
E. HARTFORD
GLASTONBURY
COLUMBIA
Zerrubbabel Collins
NORWICH
CAPE COD
CONNECTICUT
NEWPORT
John Stevens I
NEW HAVEN
STRATFORD
POST ROAD
LONG ISLAND SOUND

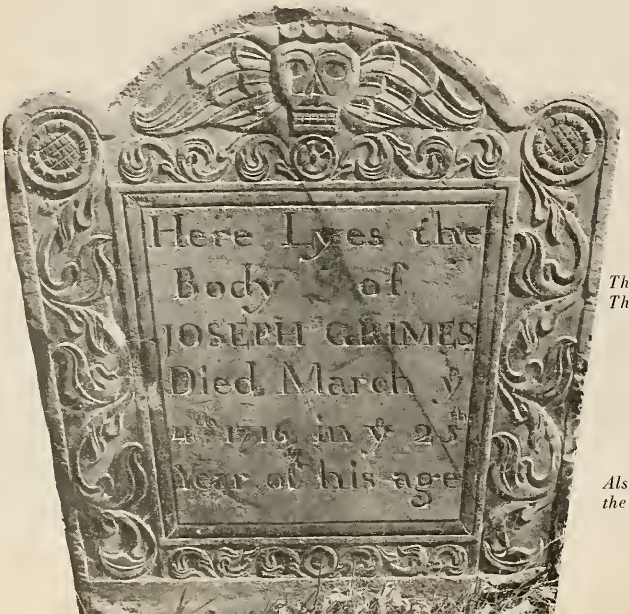
Some Gravestone Locations and Movements of Carvers item, be it a style of pottery or a way of making an arrowhead, has a particular popularity period, and as it grows and wanes in popularity, its prevalence as time passes can be represented graphically by a single peaked curve. Small beginnings grow to a high frequency of occurrence, followed in turn by a gradual disappearance. If such an assumption is true, it follows that a series of sites can be arranged so that all artifact types within them form single peaked curves of popularity over time. Such an arrangement is chronological, and tells the archeologist how his sites relate to one another in time.

By plotting style sequences in this manner in a number of cemeteries, we find that the assumption, not previously measured with such a degree of precision, is a sound one: styles do form single peaked popularity curves through time. By adding the control of the spatial to the form—time pattern explained above, we gain a number of understandings regarding diffusion—the spread of ideas through time and space and how this, in turn, affects internal change in style. In looking now at the three dimensions we will see that all of the secondary cultural controls become even more important.

The style sequence of death's head, cherub, and urn and willow design is to be found in almost every cemetery in eastern Massachusetts. However, when we inspect the time at which each change takes place, and the degree of overlap between styles from cemetery to cemetery, it becomes apparent that this sequence was occurring at a widely varying rate from place to place. The earliest occurrence of cherubs is in the Boston-Cambridge area, where they begin to appear as early as the end of the seventeenth century. Occasional early cherubs might be found in more distant rural cemeteries, but in every case we find them to have been carved in the Boston area and to be rare imports from there. The farther we move away from the Boston center, the later locally manufactured cherubs make their appearance in numbers. The rate at which the cherub style spread outward has even been approximately measured, and shown to be about a mile per year. It is not common in archeology to make such precise measurements of diffusion rate—the usual measurements are cruder, such as hundreds of miles in millenniums.

We can view Boston and, more significantly, nearby Cambridge as the focus of emphasis of Puritan religion with its accompanying values, and inquire what factors might contribute to the initial appearance of cherubs and the change in religious values in this central area. We have noted that the change had already been accomplished in England by the early eighteenth century, so that when the first cherubs begin to appear in numbers in Cambridge, they were already the standard modal style in England. While cherubs occur in Boston, they never make a major impression, and as many death's heads as cherubs are replaced by the urn and willow influx.

On the other hand, in Cambridge cherubs make an early start and attain a respectable frequency by the late eighteenth century. Although they never attain a full 100 per cent level there, as they do in most rural areas, they do at least enjoy a simple majority. When the cherub stones in Cambridge are inspected more closely, we find that roughly 70 per cent of them mark the graves of high status individuals: college presidents, graduates of Harvard, governors and their families, high church officials, and in one case, even a "Gentleman from London." From what we know of innovation in culture, it is often the more cosmopoli-



At left is the Joseph Grimes stone, 1716, Stratford, Connecticut.

The Margaret Hall stone, 1782, is in The Granary, a burial ground in Boston.

Also located in The Granary is the John Hurd stone, 1784, at far right.

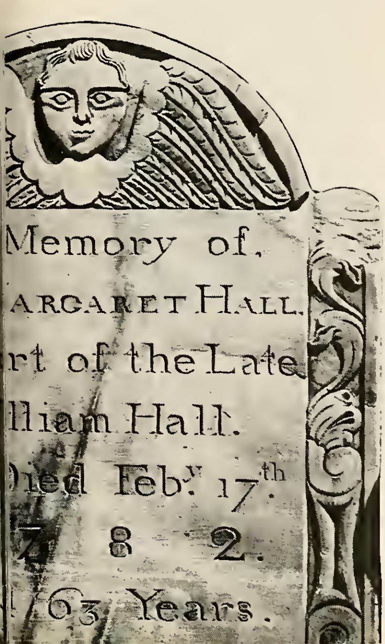
tan, urban stratum of society that brings in new ideas, to be followed later by the folk stratum. If this is true, then the differences between Boston and Cambridge indicate a more liberal element within the population of Cambridge, reflected in the greater frequency of cherub stones there. This is probably the case, with the influence of the Harvard intellectual community being reflected in the cemetery. It would appear that even in the early eighteenth century, the university was a place for innovation and liberal thinking. Cambridge intellectuals were more likely to be responsive to English styles, feelings, and tastes, and this could well be what we are seeing in the high number of cherub stones marking high status graves.

Introduced into Cambridge and Boston by a distinct social class, the cherub design slowly begins its diffusion into the surrounding countryside. Carvers in towns farther removed from Cambridge and Boston—as far as fourteen miles west in Concord—begin to change their gravestone styles away from the popular death's head as early as the 1730's, but fifty miles to the south, in Plymouth, styles do not change until the fifties and sixties and then in a somewhat different cultural context. We find, however, that the farther the cemetery is from Boston, and the later the cherubs begin to be locally manufactured, the more rapidly they reach a high level of popularity. The pattern is one of a long period of coexistence between cherubs and death's heads in the Boston center, and an increasingly more rapid eclipsing of death's heads by cherubs in direct proportion to distance, with a much shorter period of overlap. One explanation is that in towns farther removed from the diffusion center, enforcement of Puritan ethics and values would lessen, and resistance to change would not be so strong. Furthermore, revivalism and the modification of orthodox Puritanism was widespread from the late thirties through the sixties in rural New England, although this movement never penetrated Boston. Such activity certainly must have conditioned the rural populace for a change to new designs.

We have, then, a picture of the introduction of a change in the highly specific aspect of mortuary art, an aspect reflecting much of the culture producing it. We see the subsequent spread of this idea, through space and time, as a function of social class and religious values. Now we are in a position to examine internal change in form through time, while maintaining relatively tight control on the spatial dimension.

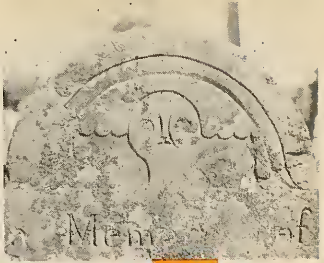
One significant result of the use of gravestone data with its accompanying controls is the insight it provides in matters of stylistic evolution. The product of a single carver can be studied over a long period of time, and the change in his patterns considered as they reflect both ongoing culture change and his particular manner of handling design elements. The spatial axis extending outward from Boston shows not only systematic change in major style replacement rates but also a striking pattern of difference in style change. We find that in many cases, the farther removed we become from Boston, the more rapid and radical is change within a given single design. This has been observed in at least five separate cases, involving a number of the styles of more local distribution; we can inspect one of these cases closely, and attempt to determine some of the processes and causes of stylistic evolution.

The design in question is found in Plymouth County, centering on the town of Plympton. Its development spans a period of some seventy years, and the changes effected from begin-



To
The Memory
of
JOHN HURD
1 7 8 4

The final, simplified form of the Medusa design is usually found on graves of children under the age of five. Children's stones, it is surmised, are a stylistically conservative element in the population of a cemetery, reflecting past rather than contemporary style in mortuary art.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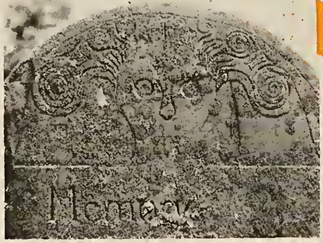
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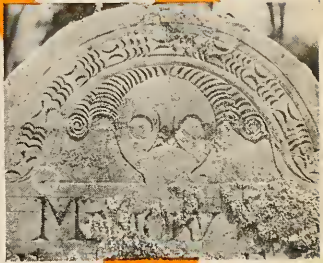
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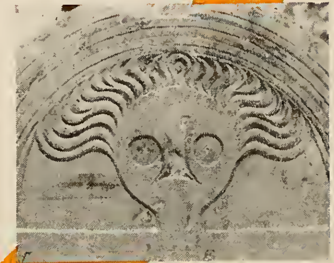
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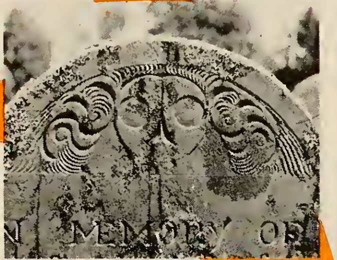

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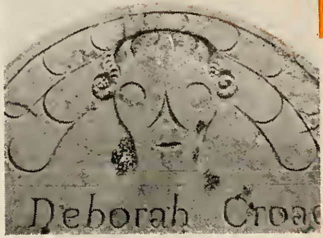

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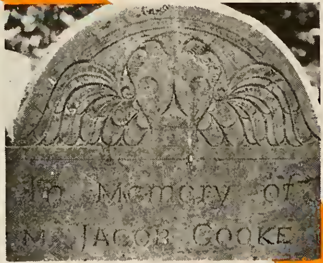

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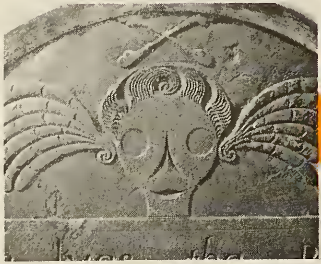
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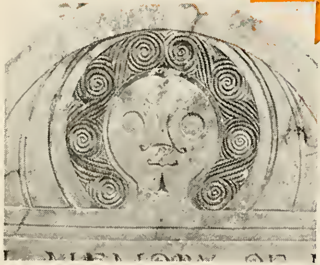
The third and most distinct style—but nevertheless related to the Medusa and multiple halo designs—is characterized by rather conventional wings, tightly curled hair, and faces similar to its stylistic precursors. Note that, as in the Medusas, 7 through 10, the heart-shaped mouth is eliminated. In general, this design is found geographically west of the other two styles.

Evolution of Styles in a Plympton Cemetery

In the second major branch from stone 5, the undulating lines of the feather ends are removed entirely by stone 17, leaving a face ringed with multiple halos. The heart-shaped mouth has been modified into a simple T.



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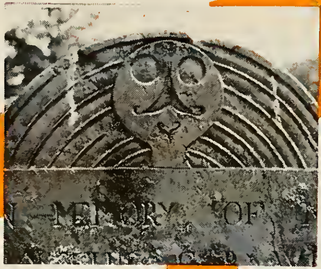

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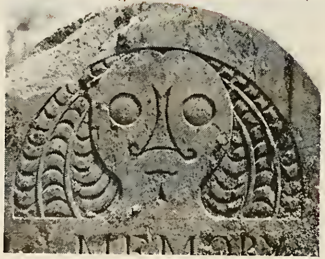

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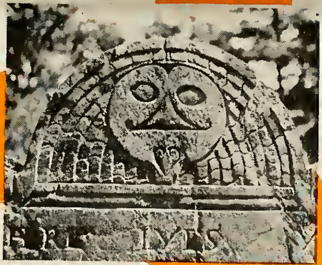

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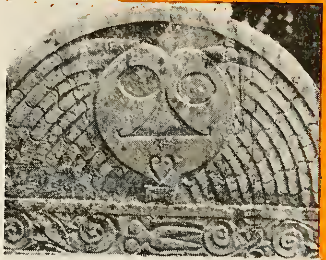

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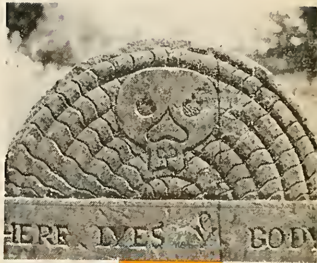
In an early phase—ending at stone 4—of the style sequence in Plympton County, Massachusetts, teeth are lowered and finally disappear, as heart-shaped element becomes the mouth. Note in stones 3 and 5 that every other row of feather ends is reversed, creating wavy lines that, in the right-hand branch leading from stone 5, evolve into curled hair of the "Medusa" design, stones 7 through 10.



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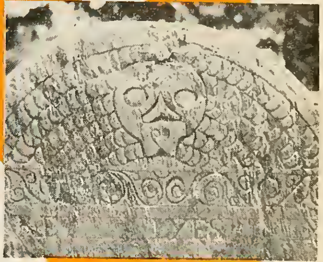

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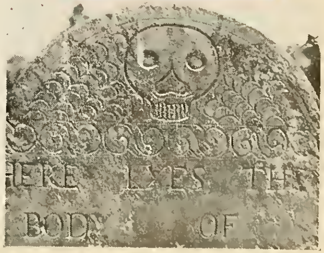

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ning to end are truly profound. Death's heads occur in rural Plymouth County, as they do elsewhere in the late seventeenth century. However, in the opening decade of the eighteenth century the carver(s) in Plympton made certain basic changes in the general death's head motif. The first step in this modification involved the reduction of the lower portion of the face, and the addition of a heart-shaped element between nose and teeth. The resulting pattern was one with a heartlike mouth, with the teeth shrunken to a simple band along the bottom. The teeth soon disappear entirely, leaving the heart as the sole mouth element. This change is rapidly followed by a curious change in the feathering of the wings.

While early examples show all feather ends as regular scallops crossing the lines separating individual feathers, shortly after the first changes in the face were made, every other row of feather ends had their direction of curvature reversed. The resulting design produces the effect of undulating lines radiating from the head, almost suggesting hair, at right angles to curved lines that still mark the feather separation. These two changes, in face and wing form, occupy a period of 35 years from 1710 through 1745. During the later forties this development, which has so far been a single sequence, splits into two branches, each the result of further modification of wings. In the first case, the arcs marking feather separations are omitted, leaving only the undulating radial lines. Rapid change then takes place, and soon we are confronted with a face surmounted by wavy and, later, quite curly hair. The heart mouth has been omitted. We have dubbed this style "Medusa." In the second case, the separating lines are retained, and the undulating lines removed; the result in this case is a face with multiple halos. At times, space between these halos is filled with spiral elements, giving the appearance of hair, or the halos are omitted entirely. The heart-shaped mouth is retained in this case and modified into a T-shaped element.

Both of these styles enjoy great popularity in the fifties and sixties, and have slightly different spatial distributions, suggesting that they might be the work of two carvers, both modifying the earlier heart-mouthed design in different ways. Yet a third related design also appears in the forties, this time with tightly curled hair, conventional wings, and a face similar to the other two. Although this third design seems to be a more direct derivative of the earlier death's head motif, it is clearly inspired in part by the Medusa and multiple halo designs. This tight-haired style has a markedly different spatial distribution, occurring to the west of the other two, but overlapping them in a part of its range. Of the three, only the Medusa lasts into the seventies, and in doing so presents us with something of an enigma. The final form, clearly evolved from the earlier types, is quite simple (*illustration, page 34*). It has a specific association with small children, and has never been found marking the grave of an adult, and rarely of a child over age five.

The carver of the fully developed Medusa was probably Ebenezer Soule of Plympton; a definitive sample of his style is found in the Plympton cemetery. Normal Medusas, except for the late, simple ones marking children's graves, disappear abruptly in the late sixties. In 1769, and lasting until the eighties, stones identical to Soule's Medusas, including the simple, late ones, appear in granite around Hinsdale, New Hampshire. Fortunately, a local history has identified the carver of some of these stones as "Ebenezer Soule, late of Plympton." This alone is of great interest, but if Soule did move to Hinsdale in 1769, who carved the later children's stones in Plymouth County? As yet, no answer is known.

This development raises two interesting considerations. First, we see that a style, the Medusa, which had been used for the general populace, ends its existence restricted to small children. This pattern has been observed elsewhere, with children's burials being marked by designs that were somewhat more popular earlier in time. In other words, children are a stylistically conservative element in the population of a cemetery. While no clear answer can be given to this problem, it may well be that small children, not having developed a strong, personal impact on the society, would not be thought of in quite the same way as adults, and would have their graves marked with more conservative, less explicitly descriptive stones.

The second problem raised by the Medusas is their reappearance in Hinsdale. If, as archeologists, we were confronted with the degree of style similarity seen between Hinsdale and Plympton in mortuary art, might we not infer a much greater influence than a single individual arriving in the community? After all, mortuary art would be about the only distinctively variable element in material culture over eighteenth-century New England, and such a close parallel could well be said to represent a migration from Plympton to Hinsdale. One man moved.

Placing this striking case of stylistic evolution in the broader context of culture change and style change in eastern Massachusetts, we find that it is paralleled by other internal modifications of death's hea designs in other remote rural areas The closer we move toward Boston the less change takes place withi the death's head design, and in Boston proper, death's heads from 181 are not that different from thos from 1710. Yet 1710 death's head in Plympton and elsewhere ha changed so radically by 1750 that i is doubtful that we could supply th derivation of one from the other i the absence of such an excellentl dated set of intermediate forms. Thi difference in rate of change can b explained by referring back to th long, parallel courses of development of both death's head an cherub in the diffusion area's Bosto center. However, culture change i the area of religion, marked by shift of emphasis from mortality t immortality, probably generated desire for less realistic and less gri designs on stones. Given this basi change in religious attitudes, wha were the alternatives facing carver in Boston as opposed to the Ebeneze Soules of rural New England? I Boston it was simply a matter c carving more cherub stones an fewer death's head stones; neithe had to be altered to suit the ne tastes. The choice between cheru and death's head in Boston has bee seen as ultimately a social one, an if there was a folk culture component within Boston, there was nothing but folk culture in the more democratic, less-stratified rural areas. With no one to introduce cherubs and to call for them with regularity in the country, carvers set to work modifying the only thing they had—the death's head. The more remote the community, the later the local cherubs appear, diffusing from Boston, and the more likely the tendency to rework the common folk symbol of skull and wings. Thus we get Medusas and haloed T-mouthed faces populating the cemeteries of Plymouth County until cherubs finally appear. Even then, the waning popularity of the death's head in this area might be more the result of Soule's exit than their unsatisfactory appearance compared to the new cherubs.

Only a few applications of gravestone design analysis have been detailed here. A three-year program is presently under way, through which we hope to pursue numerous other aspects of this fascinating study. There is a large and important demographic dimension to these data; since precise date of death is given, as well as age at death, patterns of mortality and life expectance through time and space can be detailed. The results of this work, in turn, will add a biological dimension of style to the cultural one described above. Studies of diffusion rate, and its relationship to dating by seriation will be continued. Relationships between political units — counties, townships, and colonies—and style spheres will be investigated to determine how such units affect the disribution of a carver's products. Finally, a happy by-product will be he preservation on film of over 5,000 gravestones, a vital consideraion in view of the slow but steady deterioration these informative artiacts are undergoing.

Aside from the value of this work o archeology and anthropology in eneral, one final comment must be made. Compared to the usual field work experienced by the archeoloist, with all of its dust and heavy shoveling under a hot sun, this type f archeology certainly is most attractive. All of the artifacts are on op of the ground, the sites are close o civilization, and almost all cemeries have lovely, shady trees.

Part II

Predators and Scavengers

Jackals and hyenas feed on what other animals kill, but also take live prey

By Richard D. Estes

If we consider what wild dogs, cheetahs, leopards, and lions have in common, not counting similarities based on ancestry and size, we find that all depend almost entirely on what they kill for themselves, and that perfectly fit adults of a few species are their usual prey. This is why I call them "pure" predators. With the scavenger-predators the pattern is almost reversed. As scavengers, they live as much as possible on the kills of other species and on carrion; as predators, they specialize on helpless young and unfit adults. This kind of predation is rather typical of canids; the purest predators are cats. The wild dog departs from its family pattern—as it also departs anatomically in having four instead of the standard five toes on the front feet. But jackals and hyenas fit the basic canid-predator pattern, de-

parting from it only to the extent of their specialization as scavengers.

Jackals might better be called predator-scavengers than scavenger-predators, since they are anatomically no more specialized for scavenging than dogs. In appearance and behavior they strongly resemble foxes, which in certain regions are also known for their scavenging habits. In their readiness to capitalize on whatever nutritional opportunities the environment affords, both simply display typical canine adaptability. Hyenas, on the other hand, are structurally adapted for a specific scavenging role by their remarkably developed jaws and carnassial teeth, which give them the capability of cracking and eating all but the largest bones. Where hyenas are relatively scarce, as in Nairobi National Park, one often finds nearly intact skeletons of old kills. But in Ngorongoro it is rare to find even an intact bone. Only the principal bones of elephant, rhino, and hippo, and the horns of bull wildebeest (gnu) and eland, with cranium attached, are too massive for the hyena to crack. To extract nutrients from bone and some of the other objects that only hyenas have the imagination to eat, they probably also have a specialized digestive system. But these specializations in no way detract from their predatory capabilities; they merely supplement them.

The relative importance of scavenging and predation in the lives of jackals and hyenas must vary enormously according to both time and place. Where pure predators and their prey are plentiful, they may live largely as scavengers if they themselves are not too numerous. Where pure predators are scarce, they may be very active hunters; in fact, they may even partially fill a predator's vacated niche. Thus side-striped and black-backed jackals in South Africa are known to kill prey much bigger than themselves and are considered a serious menace to sheep; in East Africa, where the whole array of predators is still represented, jackals rarely kill anything larger than a gazelle fawn. Comparable examples are found in Europe and America where foxes and wildcats become predators on juvenile and even adult deer in the absence of wolves and mountain lions. Clearly then, the role of scavenger-predator is flexible and opportunistic, so that the only rule

A foraging spotted hyena prowls past wildebeest (gnu) cows and calves without causing a great disturbance.

An adult wildebeest moves away from the path of a wild dog that is searching for its usual quarry, a juvenile wildebeest.

that might apply is one that recognizes the carnivore's predisposition to follow the path of least effort—as long as carrion and the leavings of other predators suffice, the scavenger-predator will not engage in much hunting.

From dead and crippled small creatures of species not normally vulnerable to them, right up to the largest herbivores, almost every form of animal protein that the environment produces ultimately becomes food for scavengers. In the jackal's case, but apparently not the hyena's, a variety of berries and fruits is a part of the normal diet. Both black-backed and golden jackals came into camp to eat figs when the trees ripened twice a year, while I never knew hyenas to eat them. Hyenas, however, are willing to try many things that have no appeal for jackals: pots and pans, rain gauges, plastic hosepipe, and nylon rope, to mention a few of the items pilfered from my camp.

Thus, scavenging may be seen as an added dimension that gives those carnivores that practice it the potential to increase far beyond the bounds imposed on pure predators. Of course, not every scavenging carnivore succeeds equally. The striped hyena, for example, is scarce compared to the spotted hyena. Success calls for precisely the right combination of attributes; a species with antisocial, retiring habits, which is largely restricted to habitats with limited food resources, obviously will not fare as well as a gregarious one capable of exploiting a variety of habitats. Such differences may explain why the striped hyena loses out in competition with its bigger, bolder relative. It must be their ability to exploit scavenging to the limit, added to their abilities as predators, that accounts for the numerical ascendancy of the spotted hyena and jackals.

The scavenging activities of these animals are so well documented that there is no need here to give more than the briefest account before going on to consider their largely ignored predatory behavior. Jackals and hyenas, vultures, and several scavenging eagles all monitor one another's activities and are highly adept at interpreting behavior that indicates the presence of food. Hungry jackals and hyenas frequently scan the sky by day, and at the sight of vultures spiraling down to a kill, all within half a mile converge on the spot, racing to get there in time. For their part, vultures are so alert to the movements of the carni-

The Grant's gazelle fawn, even though caught and throttled by a black-backed jackal—one of a hunting pair—ultimately escaped through the efforts of two adult female gazelles.

vores that they may actually anticipate a kill by a wild dog pack by alighting before the prey is even pulled down.

The interdependence of the scavengers may be seen most strikingly during the wildebeest calving season, when they congregate on the calving grounds to consume the afterbirths of the several hundred gnus born every day. The hyena, being mainly nocturnal, is less in evidence by day than the jackals and vultures. On the other hand, the vultures are strictly diurnal; the heavier vulture species are further limited to the period between about two hours after dawn to one hour before dusk by dependence on thermal updrafts for soaring.

At kills there is a definite rank order among scavengers, based on size. All yield their places to the hyena; jackals lord it over the vultures; and when their turns come, the big species push aside all the lesser ones right down the line to the smallest vulture, which must make do with the last gleanings. But generally speaking, hyenas and jackals predominate by night, and vultures by day.

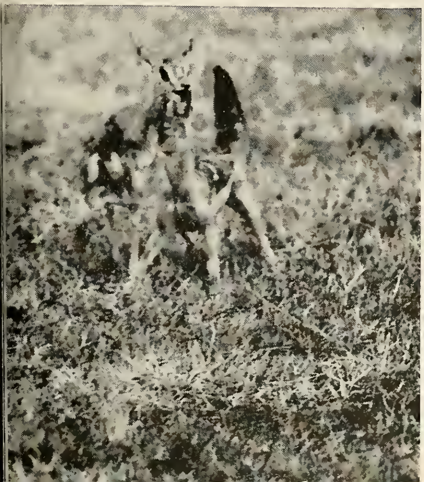
As predators, jackals consume everything from insects to young gazelles. They hunt rodents, seek out the nests of grassland birds, and regularly forage under trees inhabited by colonies of weavers and waders. When newly hatched tree ducks flutter from the nest holes to the ground on their way to the nearest water, as often as not, some jackal will be waiting below to receive them with open mouth.

Between them, even though they specialize on fawns alone, the two dominant jackals probably kill more of the Crater's gazelles than the other seven or eight potential gazelle predators combined. This is simply because they are so numerous and so active at their specialty. Hyenas, less interested or less adept in hunting gazelle fawns, apparently take them only incidentally. But both jackal species may be seen hunting fawns at any time of the day, and they often hunt in pairs, which is much more effective than hunting singly.

The habits of the two jackals are similar but not identical. They could not, in theory, coexist in the same niche, although they seemingly come close to it in the Crater. In overall distribution, however, their ranges scarcely overlap, the golden's extending over much of Asia down through East Africa, while the black-backed is wholly African, predominating farther south. Where they do overlap, their habitat preferences also differ somewhat, the black-backed being found in more wooded country than the golden. This implies differences in food resources as well. The degree of overlap and apparent competition between them in the Crater is thus not typical. Even here, intensive study might well disclose differences in food habits. About the only difference I have noted, though, is in their activity periods, and even that is not very clear. Judging by their presence at kills, the black-backed appeared more active by night, the golden more active by day.

As soon as the predatory behavior of hyenas is considered, controversial questions arise. Whether hyenas resort to active predation is, of course, hardly open to dispute: neither natural game mortality nor the predation of 12-odd adult lions could possibly support the 600 or more hyenas in the Crater. The question is, do they confine their predation to the young and the very old, the crippled and the diseased, or do they also hunt and kill perfectly healthy adults? This is a difficult point to settle, simply because a human observer can rarely be certain that an apparently healthy animal selected by hyenas is really perfectly fit. Dr. Hans Kruuk of the Serengeti Research Institute, after following Crater hyenas on numerous moonlight hunts, was nearly convinced that hyenas in packs chase and capture healthy adult gnus and zebras. I have also followed nocturnal hunts and seen them pull down the same prey, yet I remain unconvinced—for several reasons—that the animals were really perfectly sound. Since those reasons are based on the hyena's usual hunting methods and choice of prey, and on the way game reacts, these must be outlined before returning to this special case. But perhaps the question can never be settled to everyone's satisfaction—certainly not without really convincing evidence, which would require great effort and ingenuity to collect.

If I question the capacity of human observers to detect some subtle flaw in a healthy looking animal, it is because I know that a hyena's powers



of observation are greatly superior to man's. I have seen too many demonstrations of its almost uncanny ability to select the vulnerable member of a herd to doubt it. Consider, for example, the way it singles out newborn wildebeest calves, of which Ngorongoro's hyenas kill many more than all other predators combined.

Gnu calves, although able to stand and run within seven minutes after birth, are unable for the first two or three days to keep up with their mothers in a long chase. After that, it is hardly worth a hyena's while to chase them, unless one can be separated from its mother and the herd. Consequently, hyenas look for newborn or orphaned calves and largely ignore others. Having spotted a new calf, a hyena will immediately pursue and usually overtake it within a quarter to half a mile. While older orphan calves may lead them a merry chase for miles, newborn orphans will walk right up to a hyena or anything else that moves—a disastrous miscarriage of its innate following response. Every one of roughly a dozen calf kills that I have examined proved to be newborn, as revealed by the condition of the umbilical cord and the softness of the hoofs. Although I found it a practical impossibility to single them out, once dry, from among hundreds of slightly older calves, hyenas evidently notice something different about the newborn, possibly a slight unsteadiness and irregularity in the gait.

Even hyenas are often baffled, however, when they set out to catch a new calf in a big concentration. At the first alarm the mother immediately leads its calf into the nearest herd. The tactic of losing itself in a herd is the gnu's first and most effective line of defense. Only if the calf is overtaken is there any active defense, and then only by the mother. The habit of congregating on calving grounds and the short peak calving season itself are adapted to protection of the young and may have developed in response to hyena predation alone. That calves born before the peak or in small herds are the least likely to survive supports this idea. During the 1965 calving season, the mortality rate in the calving-ground concentrations ran at an average of 20 per cent, while in the smaller herds it reached 50 per cent, practically all of it attributable to hyena predation.

The basic hunting technique employed by the spotted hyena, whether singly or in loose packs, is to run at herds and make them move. This is an effective way to spot an unfit herd member, visually if it lags behind the rest, or by scent—the hyena's nose is a highly refined instrument. While collecting data on the wildebeest's nocturnal behavior, I have often seen large concentrations disturbed in this manner.

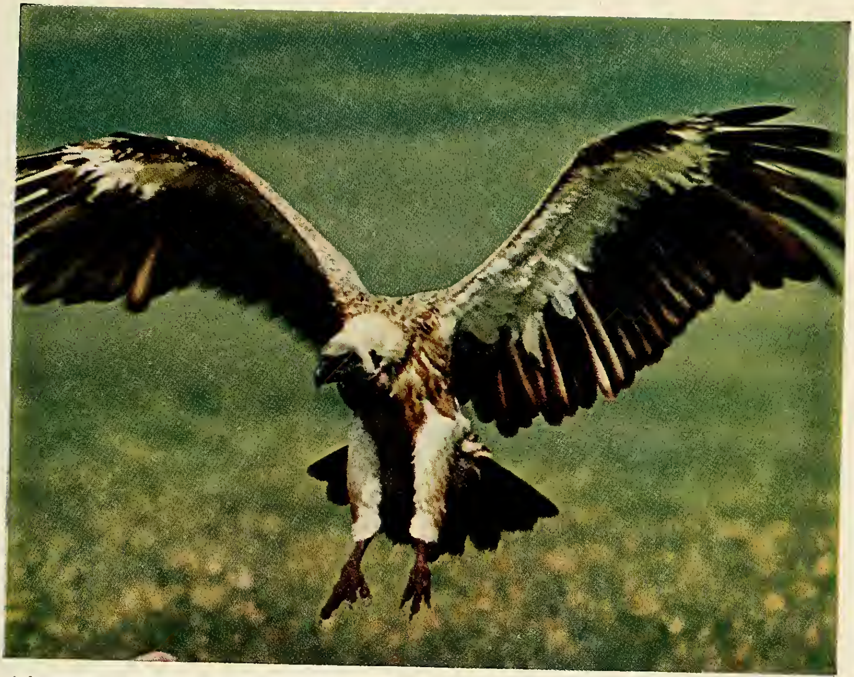
The wildebeest, while resting in their long, linear night-bedding formations, would let hyenas prowl the aisles between columns, until one ran straight at them. The threatened animals would then rise together and gallop off for perhaps 100 yards. Once the group was started the hyena usually stopped and stood looking after them; having presumably failed to see or smell a likely prospect, it would continue prowling. I have often seen hyenas work this method in teams, one looking on from the sidelines while the other loped into the herd.

When they did follow through, they quickly got among the nearest gnus. This caused the group to scatter in all directions but did not, by any means. lead to panic. To be sure, only the rare territorial bull will stand its ground directly in the path of a running hyena. But wildebeest adults in general fail to show symptoms of great fear and exert themselves no more than is necessary to get out of the way. In the same circumstances, they react in exactly the same fashion to wild dogs, which rarely molest adult wildebeest. Zebras are even less intimidated by hyenas and wild dogs and frequently attack them if they come close. But this does not apply to females with young or, probably, to individuals that are handicapped in some way—as by late pregnancy, disease, parasite infestation, or an injured leg. They are the ones the hyenas are seeking. But as long as they can stay in a herd they have a chance, and one sees a surprising number of animals with serious injuries, including even a few with broken legs, that manage to evade the hyenas and recover.

These considerations lead me to doubt that hyenas pull down many adults that are perfectly healthy. That wildebeest and zebra show an otherwise inadequate flight response to hyenas argues that it is not a normal occurrence. It is possible, of course, that the Ngorongoro hyenas have started something new and the game simply hasn't adjusted. With so many hyenas and so few lions, one could well conceive of strong pressure in favor of new methods for gaining food. On the other hand, as anyone can testify who has caught or cropped normally protected game, it is remarkably quick to recognize new sources of danger.

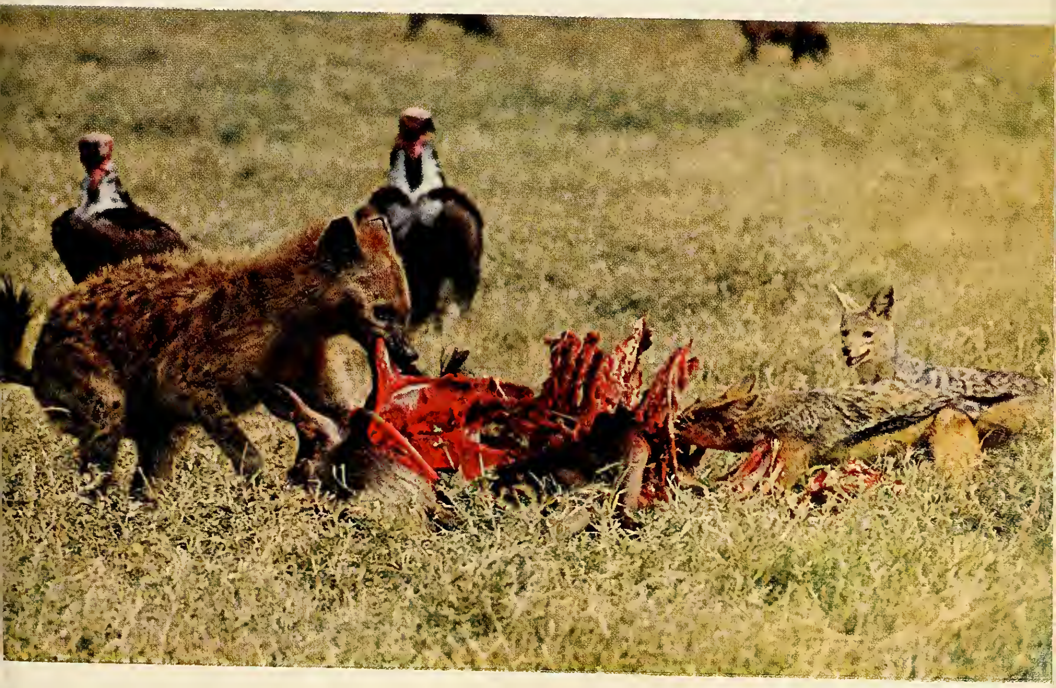
The hunting method just described, and especially pack hunting, is quite distinct from the hyena's usual foraging behavior. Indeed, its behavior as a solitary scavenger is so unlike this as to make the hyena seem almost schizophrenic. The foraging hyena is the one with the reputation of a skulking, craven coward. It is in truth a remarkably timid beast, easily routed by anything showing fight. Yet it is also known that the hyena is a notably persistent animal, which is sometimes driven by its appetite to take quite incredible risks. It will lie all day near an ostrich nest, anticipating the time when the eggs may be left momentarily unguarded. Hyenas wait for wild dogs or lions to start hunting, and once the kill is made, continue to wait—although not necessarily patiently—until they can fall upon the remains. Defenseless young or small crippled animals encountered while foraging are seized on the spot, but larger cripples may be followed for days until too weak to resist.

Beyond this point the timid forager becomes the daring predator, but precisely what triggers the transition is not easy to comprehend. Predatory behavior seems clearly to represent a higher level of excitation for the hyena, but what lifts its emotions past the predatory threshold? Surely the degree of hunger, the nature and strength of the stimuli coming from a potential meal are important; so probably is the mutual stimulatory effect hyenas have on one another. But mutual stimulation is not essential, since single hyenas also run down prey. It is quite conceivable, however, that strong competition, even when not immediately evident in the shape of other hyenas,



A descending vulture is frequently a signal to hyenas and jackals that food is nearby. This is a White-backed Vulture.

At typical kills a definite rank order among scavengers is maintained: hyenas first, then jackals (here at right), then vultures.



A hyena and a lioness confront one another on the site of a kill. Hyenas may actually steal prey before lionesses have fed.

At the rear of a wild dog pack, a hyena waits for a hunt to begin. It will, presumably, trail along and look for a chance to scavenge.

is nonetheless operative and may serve to push the individual's emotions over the predatory threshold from the simple fear of losing prospective food. While this may be hard to demonstrate in the case of the lone hunter, it is perfectly clear that hyenas in packs, unlike wild dogs, are not so much co-operating with each other as competing to be first. In short, high population density may be a major underlying factor in hyena predatory behavior.

Even the lion, when very young, aged, or unwell, is fair prey for hyenas. Cubs are vulnerable when left alone, as they often are, but usually they remain hidden in dense vegetation, never stirring until an adult comes looking for them. I have myself seen a lion in his prime, starving with a broken leg, relentlessly followed by hyenas. Another time, I watched 12 hyenas advance shoulder to shoulder with tails erect—a sure indicator of aggressive intent—to within three yards of a pair of lionesses, one of which was suffering from an abscess. When the lionesses retreated, the hyenas spent minutes excitedly sniffing their resting place. Amusingly enough, they then got mixed up and advanced on the wrong lioness, who had only to turn her head and stare at them with flattened ears to transform them back into meek scavengers.

Clearly the spotted hyena is far more resourceful and formidable than its reputation would suggest. It only remains to describe one other food-gathering technique that transcends all the rest in ingenuity and daring. John Goddard and I have photographic proof that hyenas rob wild dogs of their prey at the moment of capture; I also have good evidence —although not final proof—that they work the same trick on lions.

When wild dogs begin a chase, one or more escorting hyenas often run with them. While unable to match the leader's pace, they are apt to end up far ahead of the straggling main pack when the quarry is overtaken. Hyenas passed en route may also dash in at the finish. In this way they have an opportunity to seize the quarry if it doubles back on its tracks, or just after one of the lead dogs has caught it. If it is no bigger than a Thomson's gazelle, they sometimes succeed in running off with it; should it be too big to carry, or if other members of the pack are close behind, usually the hyenas are quickly routed. Since the latter, lacking the true pack instinct, will not defend one another, they are totally outmatched by a pack of wild dogs. But the seemingly obvious risk of being mauled never deters them from trying, and quite often they succeed unless the pack keeps together and on guard.

This technique, only slightly modified, is also used on lions, I believe, with no greater risk and possibly with better success. My evidence suggests the following may be typical:

A lioness hunting at night is trailed by several hyenas who remain close as she stalks a wildebeest or zebra. When the lioness finally charges, they too rush forward, and as she grasps the prey's head and shoulder, they close in and begin tearing at its hindquarters. This interference may so disconcert the lioness that she lets go prematurely and the gnu or zebra gallops away with more or less serious wounds. It would be untypical lion behavior for her then to chase after it, since following up an unsuccessful charge is generally fruitless (remember that felids rely on surprise). But the hyenas now have an instant cripple to follow, and waste no time chasing, capturing, and finishing what the lioness began.

This trick might succeed only one time in 20—or about as often as it succeeds with wild dogs. But trying it on a single lioness is conceivably less risky than trying to rob a pack of dogs. At the moment of capture, the lioness's weapons are entirely committed to its prey; before it can strike at a hyena it must let go, and this gives the hyena time to leap out of the way. In my view, this "second-hand" hunting is simply the ultimate expression of the hyena's competitiveness as a scavenger-predator, of which progressively more extreme examples have been given. One step further—outright predation on fit adult big game—and it becomes a fully emancipated predator.

Since I have never actually seen this technique enacted from start to finish, probably it would be best to present such firm evidence as I have and let the reader draw his own conclusions. Of the two least ambiguous incidents that will be cited, the first took place on a dark night in May, 1965, when my wife and I were watching a resting concentration of some 500 wildebeest. We were taking turns observing them through an infrared telescope at 15-minute intervals, recording their activity with the aid of a tape recorder. I happened to be looking through the scope when the main concentration, only 40 yards from our car, suddenly rose and ran silently to a distance of about 300 yards. Swinging the scope in the opposite direction, I caught a ghost-like image of a running lion at the outer limit of the infrared beam—probably 100 yards distant. Then, nearer at hand, I spotted several running hyenas and, just ahead of them, a single fleeing wildebeest. As I started the car and circled, more hyenas showed up in the headlights, all running in the same direction. But I continued in the direction of the lion and we soon came upon two lionesses. As we both remarked at the time, they were looking about in a baffled way. Presently they walked off. As we were watching them go, a great clamor broke out behind us; we drove over to find some two dozen hyenas eating a newly killed wildebeest bull.

A week later, at 9:20 P.M., while I was out alone, the rallying calls of hyenas again distracted me from the rather tedious job of recording gnu activity patterns. This time I witnessed hyenas in the act of killing a bull wildebeest. It was still running, hyenas clinging to its flanks, and just as I drove up it jumped over a 10-foot bank into the river—wildebeest regularly do this when hard-pressed.

Some 20 hyenas proceeded to kill it in the water, by pulling out and eating its internal organs one after the other as it still struggled on its feet. More and more hyenas arrived, and by the time 50 to 60 had collected, the din was indescribable. I have often wondered why the original participants never learn to be quiet and keep everything to themselves—the fact that they are competing and not co-operating may explain it. Their rallying cries, screams, and hysterical "laughter" attract not only every hyena within hearing, but sometimes lions as well.

Before this wildebeest even went down, a pride of five lions appeared beside the car and remained watching the scene by the glare of my spotlight. The three lionesses and two-year-old brother and sister were well known to me. Their prompt arrival, in addition to the muddy, possibly even bloody look of two of the lionesses, suggested that they might have caught the wildebeest first a little way upstream. However, I had no proof.

Two of the lionesses edged forward and lay crouched together within 30 yards of the kill, apparently not daring to go nearer. But presently 10 of the numerous hyenas that could not get to the kill for all the other struggling bodies began to take an active interest in them, advancing all together with tails arched over their backs. The lionesses gave the most appalling growls but were nonetheless clearly intimidated, for they gave ground. Soon the whole pride walked off downstream, leaving the hyenas in undisputed possession.

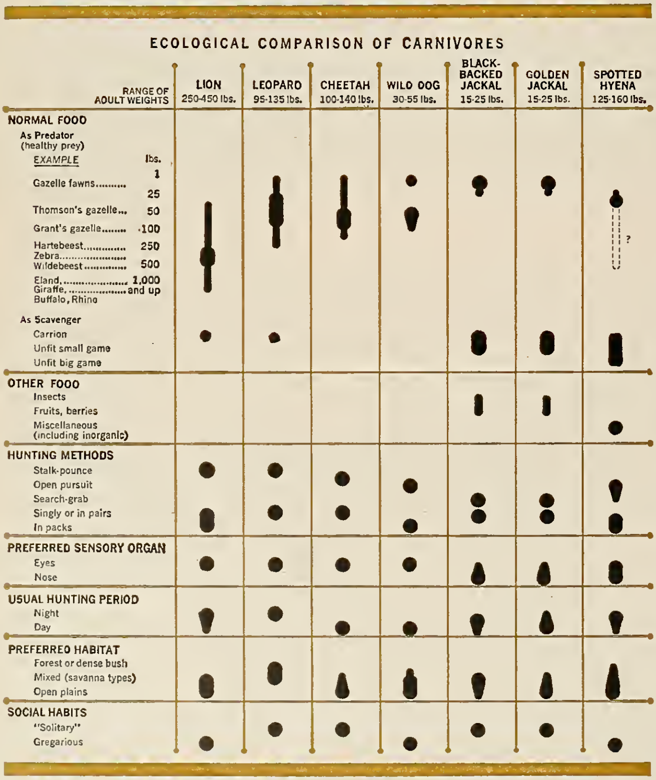
I now drove to the edge of the bank for a close look at the gnu, thereby scaring off the hyenas and gaining an unobstructed view without getting out of the car—something I was not about to do with lions nearby. The spotlight showed a row of what appeared to be claw marks, clean and white, down the bull's neck; a close-up view through binoculars, from 20 feet away, confirmed this to my satisfaction. It now seemed extremely probable that this gnu had been first caught by a lion.

The hyenas had no sooner regrouped on the carcass than a tawny form came shooting through the spotlight beam and sent them exploding from the water in all directions. I couldn't even be certain it was a lion until presently the huge, black-maned male came striding back into the light and approached the kill, looking immaculate. He gripped the gnu in his jaws and backed with it onto a gravel spit opposite the bank, moaning to himself. Here he dropped the gnu and stood over it; but instead of beginning to eat, he recrossed the stream and set off in the direction taken by the lionesses.

Deciding a minute later to follow, I had not driven far when I met two pride members coming back. They proceeded to take possession of the kill and were soon joined by a third. This sequence of events nearly convinced me that the lion had gone off to summon them back to the kill. Of course I should have known better.

The three lionesses had fed for perhaps five minutes when the old lion again streaked out of the darkness and cleared them all away, exactly as he had cleared away the hyenas. But just as before, although he paused long enough to give some full-throated roars, he went off again without feeding. For the next hour this pattern was repeated at short intervals. While he was away, sometimes the lionesses, at other times hyenas and jackals, came to feed on the kill. The only member of the pride that never reappeared was the young male. Perhaps the old lion was spending his time keeping this upstart at a distance. Eventually the patriarch settled down and ate his fill. By midnight he was gone, leaving the remains, already half-reduced when he salvaged the kill, to his inferiors. Nonetheless, but for him the pride would have had nothing or—more likely—would have had to kill again before morning. So here is the promised example of how the bully in the male lion can benefit the pride. Where hyenas gather in such numbers as in Ngorongoro Crater, it seems clear that only the lordly male has the strength and self-assurance to put them in their place.

By the time I came upon this evidence my field work was nearly finished, and there was no chance to pursue it. I can only hope now that other investigators will be able to confirm or refute my observations. If it proves to be true that hyenas actually rob lions of their prey, it would be a fascinating highlight of the relations between African predators and scavengers.



Having fed amply, a male lion washes. His presence may be crucial in keeping hyenas at a respectable distance from lionesses' kill.

THE ENIGMA OF PLUTO

By Thomas D. Nicholson

The ninth planet in the solar system, Pluto, has often been called an enigma, and indeed it is. There were some who said—and still say—that it was not the planet astronomers were looking for when it was discovered, in 1930, after a 25-year search. As more became known about Pluto, the enigma only seemed to deepen. It has the strangest orbit of all the planets; it seemed to be more like the earth and the inner planets than the giant, gaseous outer planets in the part of the solar system where it was located; it was found to be rotating slower than any known planet; and its density, based on estimates of its size and mass, appeared to be far too great.

When Uranus, the seventh planet, was discovered in 1781, the periodic acceleration of its orbit was attributed to the gravitational attraction of another, still-unknown planet. The discovery of Neptune in 1846, however, did not satisfactorily explain the orbital motions of Uranus; rather, it seemed to demonstrate the effects of still another planet. This led Percival Lowell, the American astronomer, to take up the search for a trans-Neptunian planet in 1905, a search that, after his death, was carried on at the observatory he founded, the Lowell Observatory, in Flagstaff, Arizona. Finally, on March 13, 1930, the announcement was made that the new planet, Pluto, had been found among the stars of Gemini, a dramatic climax to one of the fascinating stories of astronomy.

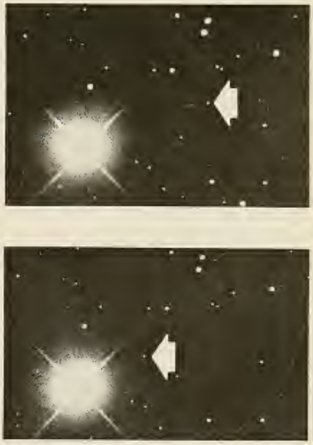
From the start, however, the discovery of Pluto produced problems. The basic one lay in reconciling what seemed to be too small a diameter for too large a mass. If Pluto were the planet responsible for the accelerations of Uranus and Neptune that had led to its discovery, it would have a mass equal to about 90 per cent of the earth's mass. Now, if Pluto nearly equals the earth in mass, how large should it be? If it had a density equal to that of earth, the densest planet known, then Pluto should be only a little smaller than the earth in size. But the other planets located, along with Pluto, in the remote regions of the solar system are much less dense than the earth, half as dense or less. On this basis, Pluto should be even larger than the earth—in fact, it should have a diameter as large as 8,700 miles.

There were other disturbing features found in Pluto. Its orbit was the strangest among the planet family, much more inclined to the orbit of earth, and much more eccentric than that of any other planet. Even more puzzling was its brightness. At its great distance from the sun, the new planet was not expected to be very bright, but Pluto was only about 15th magnitude.

This was indeed surprising. Even the larger satellites of the solar system—earth's moon, Jupiter's Galilean satellites, Saturn's Titan, and Neptune's Triton—would be brighter than 15th magnitude at Pluto's distance. Because it was so faint, some estimates of Pluto's size placed it in the class of Mercury, with a diameter about half the earth's or less. This seemed to be confirmed by Gerard P. Kuiper's measurement of its angular diameter in 1950, using the 200-inch telescope at Palomar, as 0.23 seconds of arc, equal to a linear diameter of 3,600 miles. This conflicted with the figure of 8,700 miles that was also suggested.

If Pluto were as small as its brightness and Kuiper's measurement seemed to indicate, but had a mass equal to nine-tenths of the earth's, then its mean density would have to be about 10 times that of the earth, an almost impossible situation. If it had this mass, however, and a more reasonable density (comparable to other planets), it would have to be much larger and much brighter than measurements indicated. One or the other, the diameter or the mass, had to be wrong.

In recent years at least part of the enigma has been lifted through the combined efforts of several observatories. Ian Halliday, of the Dominion Observatory, in Canada, proposed that the diameter of Pluto might be determined by observing the occultation of a star by the planet as Pluto moved slowly in its orbit between



A 25-year systematic search led to the discovery of Pluto in 1930, hidden among the many stars of Gemini, left. Taken a day apart, the photos above show the movement of Pluto (arrows) in relation to Delta Geminorum.

the earth and distant, faint stars. While it would not be possible to observe the star disappearing and reappearing during an occultation, it would be possible to determine the ime when the star disappeared and emerged by measuring the change in brightness that would occur. As Pluto approached the star very closely, the two should merge into a single object, and this merged image of Pluto and the star should be brighter than the image of Pluto alone. At the instant the star disappeared behind the planet, however, ts light would be subtracted from he image, and the brightness should hen dip to that of Pluto alone. When he star emerged again, its brightness would be added. The total duraion for which the star was covered by Pluto would, of course, indicate he size of the planet, whose rate of rbital motion was known.

More than one observatory was eeded to carry out Halliday's plan, owever. The orbit of Pluto is not nown accurately enough to predict whether the star would pass centraly behind the planet or follow a hord of the planet's disk. But if two r more observatories were involved, hen any differences measured in the eginning, ending, and duration of the occultation could be used to calculate an accurate figure for the size of the planet.

To observe the occultation that he predicted for April 28-29, 1965, Halliday enlisted the co-operation of the Dominion Astrophysical Observatory, Victoria, British Columbia; the Lick Observatory, Mount Hamilton, California; the U.S. Naval Observatory station at Flagstaff, Arizona; and the McDonald Observatory at Fort Davis, Texas. The last one was the most southerly of the four—and the most critical.

Observations were carried out at all four observatories, but at none was an occultation actually seen. But it was deduced that, although it did not occur at the observatories involved, occultation would certainly have been observed from the Southern Hemisphere. That an occultation did not occur at McDonald was significant, for this made it possible to obtain an upper limit for the diameter of Pluto. If Pluto, according to Halliday's calculations, had a diameter of more than 4,200 miles, then an occultation would have occurred at McDonald, and the records clearly indicated that it did not. Thus Pluto must be that size or smaller; it cannot be larger.

This new value for the diameter of Pluto, less than 4,200 miles, is consistent with Kuiper's measurement and with the brightness of the planet. It points to the mass of the planet as the suspicious datum. Using a reasonable value for its density (comparable to that of Mars or Mercury), Pluto should have a mass of only about one-tenth, rather than nine-tenths, of the earth's. If this is true, then Pluto cannot be responsible for the observed effects on the orbits of Uranus and Neptune. If it is not Pluto causing these effects, then what is it?

All of this seems to raise again the question: Is there another planet in the solar system? The chances are good that there is at least one more beyond Pluto. But the chances are also good that it will never be found. First of all, it was not found during the 25-year search for Pluto, and it certainly would have been if it were much brighter than that planet. Also, it does not seem likely that anyone is about to duplicate that formidable task again.

Dr. Nicholson, the regular author of this feature, is also Chairman of the American Museum-Hayden Planetarium.

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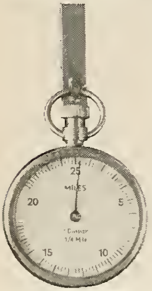

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Motion pictures of insect

by Paul Villiard

Motion pictures of insects and insect life histories are a most rewarding achievement. They are also frustrating and difficult to obtain. One problem is the small size of the subject. In still photography, a small object is not too hard to photograph. With the use of close-up lenses, lens tubes, or long-focus lenses at short distances, or even by reversing the "normal" lens to present its rear end to the subject and the front element to the film plane, such pictures are within the reach of any serious photographer.

In movie taking, however, one has a few other problems to contend with. The first is the small viewfinder area—and the resultant smaller image—which makes it difficult to see when the insect is in critical focus. Also, unless you use a reflex movie camera, you will be unable to follow the action in the finder because of parallax, and close-up focusing will have to be calculated by table, so you will have no real assurance that the entire field is critically sharp.

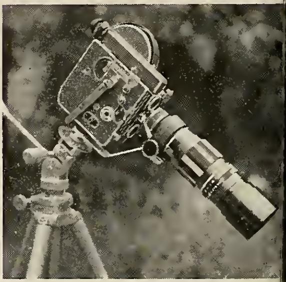
For these reasons, a reflex movie camera is almost a necessity in taking movies of insects. With this type of camera you are not limited to lenses made especially for movies. With a simple adaptor that can be made for you in any good machine shop, lenses from your still cameras can be used to great advantage. They make superb telephoto lenses, and excellent close-up work can be done with them. Several lens tubes can be used without vignetting when large lenses are adapted this way. The accompanying photograph shows the 200 mm. Takumar from my Honeywell Pentax adapted to the movie camera. This, without lens tubes, gives an image approximately eight times as large as normal on the film.

Lighting

Another problem the movie photographer has to overcome is the lack of light or, rather, getting enough light concentrated on the subject to take movies without cooking the insect. Al the more heat the insect endures, up a point, the more active it becomes. S even though you are able to illumina the field enough, you might cause t subject to come suddenly to life a run about or even depart.

Some compromise must therefore made between optimum light and o timum sharpness of image. In otl words, you may have to work with larger aperture so as not to und expose, thereby sacrificing a bit sharpness or depth of field. This is pecially true when using color film. I cause of its lower emulsion speed.

Sometimes the photographs can taken outdoors in bright sunlight place of a studio setup. When this possible, there will generally enough light to enable you to use t smaller stops and get sharper movi The big difficulty in photographi outdoors, of course, is finding a thea exactly suitable to your needs and those of the insect. Remember that y have little, if any, control over the sect under observation, and the o you are working with may be the or specimen available. It is better, the fore, to set up indoors where at le you do have control over the contr lable factors—light, background, a



A still-camera lens on a reflex mo camera will give an enlarged, yet s sharp, image of the smallest insects.

handful of people like Mary Carnwath re trying to keep our promise to the Indians. ut they won't make it without you.

The Hopi Indians' village of oaulovi in Arizona sits on land poor, infertile and inhospitable so far nobody has tried to take way from them.

Electricity has not yet reached Hopis. Water must be hauled n three miles away. Jobs are few far away. Only poverty and des- are close-by and in abundance.

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Mary Carnwath works and s two thousand miles away, in hattan. Her own daughter is grown-up, and through *Save Children Federation* she is sponng one of the village girls, 8-year- Grace Mahtewa.

The Mahtewas (two parents, e children, one grandmother a sister-in-law) live tightly ked in a tiny rock and mud e. The father who knows ranch but can't find any most of the , isn't able to provide the family even the bare necessities.

Grace, bright, ambitious and industrious, would possibly have had to quit school as soon as she was old enough to do a day's work. But, because of Mary wath, that won't be necessary. he $12.50 a month contrib- by Mary Carnwath is provid- remarkable number of things race and her family.

race will have a chance to con- schooling. The family has able to make its home a little livable. And with the money ver, together with funds from sponsors, the village has been o renovate a dilapidated build- r use as a village center. The now has two manual sewing ines that are the beginnings of ll income-producing business. nly a small beginning. More and more people like Mary wath are needed. With your perhaps this village program will produce enough money to end the Hopi's need for help. That is what Save the Children is all about.

Although contributions are deductible, it's not a charity. The aim is not merely to buy one child a few hot meals, a warm coat and a new pair of shoes. Instead, your contribution is used to give the child, the family and the village a little boost that may be all they need to start helping themselves.

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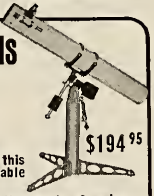

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of field, temperature to a degree, ar
so on.

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twig, a small branch, in many i
stances a potted plant are exceller
since only a small portion of the fie
will be included in the film frame
Working with long-focus lenses
short distances, the greater portion
the background will be out of foc
anyway. Indeed, it should be; a bac
ground need only be used to supply
general over-all contrast of color
the subject. A background of mediu
to dark-green material or paper, plac
just outside the depth-of-field focusi
limit, is excellent. It may also be
deep blue, which, especially in t
case of color film, will give the i
pression that the movies were tak
against the open sky.

It is not considered disparaging
take movies of wildlife in an artific
setup. To the contrary, a good photo
rapher can manipulate his props
that it never enters the viewer's mi
that the pictures have been taken ar
ficially. The great advantage is that
extraneous matter can be excluded,
that the entire attention centers on t
point of interest—the actions of the su
ject. Nor should you go to great lengt
to build an entire ecological area
habitat in your living room in which
allow your subjects to perform. N
only is it unnecessary, it also clutt
up the working area.

If, on the other hand, you are tryi
to take movies under almost impossil
conditions for the sake of being al
to explain the difficulties you ov
came in order to get them, that is
other thing. In that case, you are
so much interested in portraying
life history of an insect as you are
taking movies that another phot
rapher could not produce. If you
interested in the insect, its life, and
behavior, keep the props at a minim
and the background simple. The int
est in viewing will be centered direc
on the subject anyway, and anyth
else included in the film will mer
be a distraction.

Get to Know Your Subject

It is best to learn about whate
subject you are working with bef
you start filming. Does the insect pr
bare twigs or leafy branches? Doe
shun light or bask in the sunshine?
people, or does motion, frighten it
the extent that it will try to flee or
tempt to hide every time a move
made near it? Is it nocturnal or d
nal or crepuscular? Does it feed
quently or continuously? Does it
fer wet locations or dry ones? Th
are some of the guides you have to
up before you introduce the specin
When you learn as much as you

about the species selected for your attempts, gather whatever props are necessary and arrange them in your photographing room. Set up your lights, camera, and all accessories in place and even run through a rehearsal, focusing on anything approximately the same size as the insect. Then, and only then, get your subject and introduce him to his new environment. If it is a feeder, have its proper food right there, or it will quickly try to leave in search of something to satisfy its hunger. If an insect attempts to quit the photo field, there is little you can do to stop it. You might catch it and return it to the field time and time again, but you will not get much footage on your camera, and what you do get will probably be a series of hasty depar-ures and sudden reappearances.

Use one light source and several small mirrors to focus the light on the ield area. This is easier than a mulitude of lights and considerably ooler for the subject. It is optimum to ave the lights turned on to the full ntensity you intend to use when the ubject is introduced to its new locaion. If you deposit it there and then urn on the blaze of light, the chances re that the subject will immediately ake wing, crawl off, or depart by whatver mode of locomotion is normal.

If you are attempting a life history, ou must know enough or learn enough bout the species to be able to deterine the insect's sex, to obtain speciens of each sex, to maintain them in aptivity long enough for the cycle to e completed (usually one year), and handle them without frightening em to the point where they are tolly useless as movie actors.

Slow and deliberate motions when orking with insects are much better an quick movements. If you speak, o so in a low voice, rather than calling cross the room. Most insects can dect vibrations and are startled into ight by them. Avoid sudden changes conditions—drafts, light, heat. If the sect feeds in the daytime, that is hen the food should be offered to it. it is a nocturnal feeder, you must pply food at night.

Mantids as Models

It is a good idea to begin shooting inct movies with subjects that are more less tractable and manageable. antids make excellent subjects for rious reasons. They are easily mainined for as long as you require, proded you keep them supplied with ough living food in the form of alost any insect. Crickets are also sily kept in captivity, and both manls and crickets have the advantage size—you are working with someing you can see.

If you choose mantids, remember that the female normally consumes the male after copulation, so do not attempt to save his life by pulling them apart when she begins to feed on him. Also, the oöcyte, or egg case, must not be handled until it has hardened, and then it may be moved with the branch or whatever the female used as a support. If kept in the house until hatching time, please be cautioned that the egg case of a mantid does not hatch—it erupts! The young mantids literally boil out of the case when hatching time comes around in the spring, and unless you have kept the case in confinement, you are apt to have a house full of baby mantids all hunting for something to eat—be it whatever house bugs you have, or each other. Theoretically, they will exterminate themselves down to one, but it is better to keep the oöcyte in a small cage when hatching time is nearing. In order to maintain continuity in the life cycle movie, the case should not be detached from wherever it was made, but allowed to remain through the diapause until hatching, when the camera could be reset to film the birth sequence.

In taking life cycles that carry over long periods of time, it is good practice to make accurate notes or even diagrams of the camera locations, the light positioning, the lens used, the distance, focus, light intensity, background—in fact, everything that will enable you to set up a duplicate environment after a lapse of weeks or even months. The end result will be a smooth transition instead of a series of seemingly unrelated incidents in the life of an insect. The inconvenient alternative, of course, would be to keep the camera and props set up for the entire life-span of the subject.

This co-operative mantid waves at the camera. Shooting from a low angle with a lens tube makes a more dramatic movie.

Paul Villiard is a free-lance writer, photographer, and naturalist. A previous contributor to Natural History, Mr. Villiard has written several books ranging from a manual of veneering to a candy cookbook.

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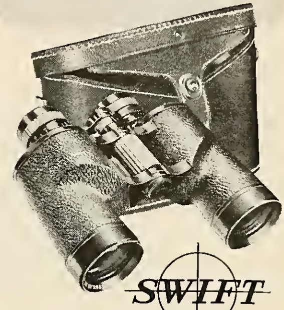

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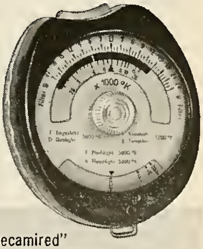

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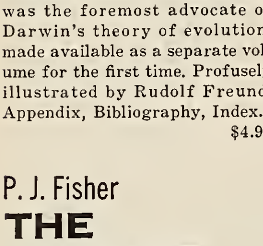

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Finding celestial objects

by James S. Pickering

By this time, your telescope will have been set up in the best and most convenient location, with as little interference as possible from trees, buildings, and extraneous light. You have checked the collimation of telescope and finder, you know the size of the field of view of your various eyepieces, and you are ready to begin.

Now, learn the sky. Go out—presumably you have done this before setting up your instrument—and observe the sky without a telescope but, perhaps, with a planisphere. Spend several evenings getting acquainted. A good, working knowledge of the skies at various seasons will pay off in the end, and there is no need to hurry. The stars and their associated clusters, nebulae, and galaxies will be there for a long time; the moon and the planets will continue their regular rounds. There may be a comet or a nova, which are temporary objects and usually unpredictable, but if such a phenomenon should occur before you are ready for it, do the best you can.

Star charts show you the sky as you face directly south and with all the star patterns—the constellations—straight up. In the sky itself, however, this is the case only when a constellation has reached its culmination—its highest point in the sky—and it is on your meridian. As a constellation rises, it will appear to be tipped to the east, to your left. If it is near culmination, it will be upright, as shown on charts. As it nears the western horizon, at setting, it will appear to be tipped to the right, to the west. For this reason, when you are seeking a small asterism—a particular grouping of stars within a constellation that may contain a nebula or cluster below naked-eye visibility—tilt your chart to correspond with the degree of progress your object has made at the time. I have spent some frustrating moments trying to recognize a small gathering of stars that surrounded my invisible goal until I remembered this trick. It is amazing how a tilt of a few degrees will make an elusive old friend recognizable.

Magnitude

"Magnitude" is a word used by the layman to mean size or importance, but to us it refers only to the brightness of a star or other object. The lower the magnitude figure, the brighter the star. Originally, the pioneer astronomers divided the stars into six different degrees of brightness. The first magnitude stars were the brightest, and the sixth magnitude stars were those barely visible to the naked eye. When the magnitude system was put on a scientific basis, the division of six principal magnitudes was retained. Now, each magnitude is 2½ times brighter than the next fainter magnitude, and so on. This works out neatly so that a first magnitude star is 100 times as bright as a sixth magnitude star.

In the process of refining the system, several stars were discovered to be too bright to be included in first magnitude. Since the number designating their brightness had to be lower than 1, zero was used, and for a few virtuosos, minus magnitudes had to be established. The brightest star, Sirius in Canis Major, is of magnitude −1.4 The sun is of magnitude −26.8; the full moon, −12.6. If each step in the magnitude scale is 2½ times in brightness, the sun is, therefore, about 400,000 times as bright as the full moon Some of the planets, when they are in their most favorable positions for observation, also fall into the minus magnitude class.

Catalogue Designations

The star designations used in mos charts for the brighter stars are th small letters of the Greek alphabe first used by Johann Bayer in 160 There is a wide belief that the orde

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of the Greek letters indicates the order of magnitude of the stars in a given constellation, but this is not always the case. Bayer sometimes lettered the stars in order of position, as in the constellation of Ursa Major, where Bayer began with the outer corner of the bowl of the Big Dipper and lettered the stars in order around the bowl and out to the end of the handle, without regard to their brightness.

The designations for clusters, nebulae, and galaxies are usually taken from one of the great catalogues of these objects, and the catalogue number is appended to the symbol. The *New General Catalogue*, which contains thousands of the brighter objects, and the *Index Catalogue*, which is an extension of the *New General Catalogue*, are represented by numbers preceded by the letters NGC or IC respectively.

Norton's *Star Atlas and Telescopic Handbook* also uses Messier's numbers, which indicate clusters, nebulae, and galaxies from the first catalogue of such objects put together by Charles Messier in the late eighteenth century. Messier catalogued 104 objects, the brightest and most prominent of their classes, and they are found in Norton and in other catalogues as numbers preceded by the letter M. All the Messier objects also have NGC numbers.

In any case, the designation of a star—its symbol, Greek letter, or whatever is used—is followed, when speaking or writing of the stars, by the genitive (possessive) form of the Latin name of the constellation. For example, the alpha of the constellation Lyra is Alpha Lyrae.

Some hundreds of the brighter stars also have individual names that have come down from many source languages. For example, this same Alpha Lyrae is also Vega, but such names are not official and are ordinarily used only for convenience. All symbols are invariably explained on star charts or in star catalogues, and the magnitude symbols are usually printed on the margins of each chart.

Planets

Planets are not shown on star charts because their positions change so rapidly. There are several publications that give the positions of the planets at various set times during the year. The *Observer's Handbook*, published by the Royal Astronomical Society of Canada, shows the positions of the planets for the 15th of each month, and also lists their various aspects. The *World Almanac* presents this information in a slightly different form. In each case, these and other almanacs will tell you when the planets are in opposition, opposite the sun in the sky, rising as the sun sets, and visible all

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ight; and when they are in conjunction, in line with the sun, rising and etting at about the same time as the un, and therefore not observable.

For complete, detailed information bout the planets and, indeed, about very other prominent celestial object, he *American Ephemeris and Nautical Almanac* is by far the best source. his book is published annually by the Jnited States Naval Observatory in Vashington, D.C., and is invaluable. imes of various phenomena are given n the *Ephemeris* in either Ephemeris ime or Universal Time, but explicit nstructions for converting these times local mean time are provided, and here should be no difficulty in making e necessary adjustments.

In the cases of Mercury and Venus, hose orbits are between the earth and e sun, the times of their greatest ongations, either east or west, are so given. These are the times when ese inferior planets are at their atest angular distances from the as seen from the earth, and can be erved best.

rs can be seen by a patient backyard ronomer. Its diameter in a telescope l be no larger than the end of a pencil.

Mercury is the most elusive of the ble planets. Because of its proxim- to the sun, it can never be seen re than 23 degrees east or west of sun. This means that, at best, it s about $1\frac{1}{2}$ hours before the sun sets $1\frac{1}{2}$ hours after the sun. Since ight can endure, in some seasons, $1\frac{1}{2}$ hours as well. Mercury can lom be seen against a completely k sky. Finding and observing Mery is a rare occurrence for the back- amateur.

enus is in a similar situation, but ause Venus is nearly twice as far n the sun as Mercury, it is not at ifficult to find when it is favorably ated. Venus is covered with a e, white cloak of clouds, and therefore, reflects sunlight better than any of the other planets. It can, at times, be the third brightest object in the sky, exceeded only by the sun or the moon. Almanacs give the times of the greatest brilliancy of Venus, which may be 15 times as bright as Sirius. These times of greatest brilliancy do not coincide with the greatest elongations.

When Venus is observed at its most brilliant, it will appear as a slender crescent without surface detail because of its cloud covering. Venus will be an evening object easily found from March to September, 1967. It reaches greatest eastern elongation on June 20, when it will be 45 degrees from the sun, setting about three hours after the sun. Its greatest brilliancy occurs July 24, and will last for a few nights. It will then slowly diminish and disappear briefly as it passes between the earth and the sun. It will be at its most brilliant again in the morning sky on October 6, 1967.

Mars is the most fascinating and the most frustrating of the planets. It is small, and in a telescope shows an apparent diameter of one per cent of the size of the full moon. It is definitely red, there is no mistake about that, but it is usually subject to distortion by the passage of its light through the earth's atmosphere. When you find Mars, stay with it. Use a low- or medium-power eyepiece at first. The planet will seem to boil and quiver, but, hopefully, there will come a time of relative stability in the atmosphere and the tiny, dancing red object will settle down. Be there when that happens, for the period of quiet will not last long. The fuzzy, red bubble will appear steady and clear and may show a tiny white cap at its winter pole.

It is too much to hope that backyard telescopes will be able to show either the scattered green areas that appear in a wide, irregular belt around the equatorial regions of Mars or the "canals." These are difficult to see without professional instruments.

Jupiter is an exciting object for the backyard observer and is not difficult to find when it is favorably situated. With good seeing conditions, the cloud bands that mark the surface of Jupiter's dense atmosphere should be visible, but the most fascinating feature of Jupiter is its family of satellites. Four of these, the largest of its twelve, are easily seen, but not normally all at once. Because the satellites are continually moving about Jupiter, one or more of them are usually occulted by Jupiter as they pass beyond it from our point of view, or they are between us and the planet and cannot be seen against its bright surface.

Many almanacs will give the configuration of Jupiter's satellites for reasonably close time intervals, and

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with luck, the observer may be able to see one of them disappear behind Jupiter or one suddenly emerge from its passage beyond the planet. It will pay the observer to stay with Jupiter on a good night to watch the slow minuet of these four bright satellites.

Saturn has always been the favorite of backyard astronomers, for the great golden ball of the planet surrounded by its halo of slightly lighter gold rings has been described as one of the truly beautiful sights in nature. For the next two or three years, however, the rings will not be at their best. Although Saturn's ring system has a diameter of about 171,000 miles, the rings cannot be as much as ten miles thick. Because of Saturn's axial inclination and the earth's position, Saturn presents its ring system to us edge-on every fifteen years, or twice during its own slow march around the sun. One of those years was 1966, and for a brief time the rings were practically invisible even in the great telescopes, for anything only ten miles wide simply cannot be seen at a distance of nearly a billion miles.

Peltier's Comet is one of many discovered by amateurs. Leslie Peltier found this one and perhaps a dozen others in many years of dedicated backyard observing.

In three or four years, however, the rings will be more open, and the backyard observer should easily see the tiny black gap between the inner edge of the rings and the planet. With excellent seeing, Cassini's division, the three-thousand-mile gap between the two main segments of the ring system, may be discerned. One and possibly two of Saturn's satellites should be apparent too—Japetus and Titan. Again, under excellent conditions, the faint cloud streaks that cross the surface of Saturn's atmosphere may be made out.

Uranus and Neptune may be picked up without too much difficulty when they are well placed. The trick here is to find them, and then to recognize them when they are found. Uranus is just at the border of theoretical naked-eye visibility and presents a tiny, faint, slightly greenish disk, with an apparent diameter of about 4 seconds of arc. It will not have the essential inner visual vigor of the stars that will surround it in the field of your telescope. At the moment, Uranus is seen among the stars of the western end of Virgo and eastern end of Leo. It is in the early morning sky this spring.

Neptune is even fainter and presents a similar appearance, although its visible disk is less than half as large as that of Uranus. It is in Libra, east o
Uranus, and in opposition this May.

Never mind Pluto. Even in the grea
professional telescopes, Pluto is a tiny
faint dot. It can be identified only b
its position and by its slight motio
against the background of the stars.

Comets

Instant astronomical fame await
the observer who discovers a comet
The annual crop of about a doze
comets is not usually spectacular
These are the old stagers making thei
regularly appointed rounds, and mos
of them never attain sufficient brightness to be seen by backyard telescopes
A fine, bright, startling comet ma
move in, however, at any time.

Most of these visitors have been discovered by amateurs—backyard astronomers. Anyone owning and using
telescope is a potential discovere
From the nature of comets and of th
orbits they follow, they are more likel
to be found when they are near th
sun, for it is from the sun that the
receive the energy that makes them bi
and visible. Sweep the western sky nea
the horizon as soon after sunset as
feasible and cover the eastern horizo
in the morning before sunrise.

Begin your search as close to th

orizon as seeing will permit, and weep slowly across the sky, moving long to take in the whole 180-degree tretch of the horizon. Then raise the ube slightly, so that you will overlap our previous track a little, and reerse your sweep. In this way, you will over the entire region and, if someing is there, you may see it. To recgnize your prey, you must be familiar ith the stars and other visible pheomena in the part of the sky you are overing. Study your charts beforeand and make a quick reference list f the nebulae and clusters in the area ou will be surveying. This may save ou some excited trips to your charts s you observe. In fact, Charles Meser, the man who made the first catague of star clusters and nebulae arly 200 years ago, started out in this ay—looking for comets. A comet, in e early stages of its excitation by the n, may not have an appreciable tail, t will be a faint, fuzzy object. Many bulae and star clusters are also int, fuzzy objects without tails. Meser ran into these in his comet seeking, d made a list to avoid disappointent and to prevent the loss of time d eye-adaptation by constant referral his charts. He did find many comets; vertheless, he is famous, not for em, but for his pioneer catalogue. is is known as serendipity, and it uld happen to you.

Comets begin to brighten and to delop their traditional tails when they about 150 million miles from the n. They may be faint, but they are finitely not stars. If you believe you ve caught one, be as certain as you n by referring to charts with great re. Determine the position of what u have seen with reference to other jects in the field and set down the estial co-ordinates and the times of ur discovery as precisely as you can. you have setting circles, note the ordinates from them. Date your rert, of course, and note the condition the sky and the quality of the see. If, after all this, you are still sure have found a comet, telephone or egraph all the details to the Harvard llege Observatory, Cambridge, Mashusetts, the clearinghouse for this t of information. Do not write. There y be other eager amateurs also on job and you must get in before the h. The Ikeya-Seki comet of late ober, 1965, was found almost simuleously by two young Japanese amars, each using a reflecting telescope is own making. Airline pilots have eral times reported the discovery of ets, simply because in early morn- or early evening flights, their occuions placed them in favorable posis to see the critical part of the sky he right time.

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—Old Chinese Proverb

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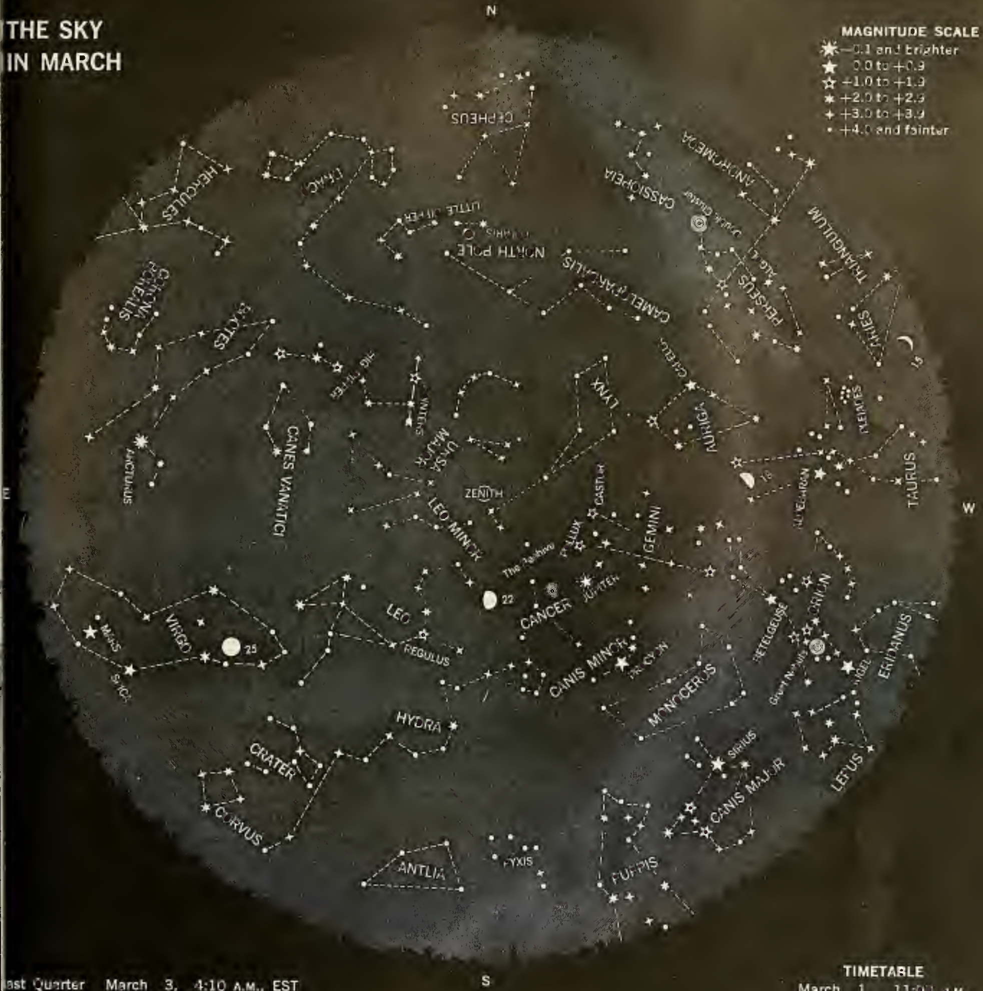
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ew Moon	March 10, 11:30 P.M., EST
irst Quarter	March 18, 3:31 A.M., EST
ull Moon	March 25, 10:21 P.M., EST

TIMETABLE

March 1	11:00 P.M.
March 15	10:00 P.M.
March 31	9:00 P.M.

(Local Mean Time)

March 4: Mercury, at inferior conjunction, enters the orning sky.

March 8: Mars, stationary in right ascension, now begins move retrograde through the constellation Virgo as it pproaches its opposition next month.

March 13: Venus and the 3-day-old crescent moon are lose in the sky this evening. By dusk, when Venus will e seen easily, the planet will be below and to the right f the moon.

March 20-21: Jupiter and the moon are close together om dusk, when they will be well up in the east, until they et in the early morning hours of the 21st.

March 21: The sun arrives over the Equator, at the posi on known as the vernal equinox, at 2:37 A.M., EST, and pring begins in the Northern Hemisphere.

Jupiter, stationary in right ascension, resumes its direct astward) motion through Gemini.

March 23: Saturn, in conjunction with the sun, enters e morning sky.

March 25-26: The full moon occurs at 10:21 P.M., EST, on the 25th. Barely five hours later, the moon will be at perigee, where it is nearest to earth; the higher perigee tide will swell the spring tide that accompanies the full moon.

March 27: Mars will rise tonight just before the moon, shortly after darkness begins, and the moon and the planet will move up the sky quite close together.

March 31: Mercury is at greatest westerly elongation (28°) and may be seen, low in the east at dawn, as a morning star for a few days before and after this date. However, this is an unfavorable elongation.

All Month: Venus (magnitude —3.4 at midmonth) is becoming brighter and more prominent as an evening star in the sunset sky. Jupiter (magnitude —2.0) is well up in the southeast at dusk and sets after midnight. Mars (magnitude —0.6) rises shortly after darkness begins and is still low in the west at dawn. Mercury may be seen briefly as a morning star at month's end, but Saturn is not in a position to be observed.

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Australia and the islands

By Hobart M. Van Deusen

Australia and the Pacific Islands, by Allen Keast. *Random House, $20.00; 298 pp., illus.* A Continent in Danger, by Vincent Serventy. *Reynal & Company, $8.95; 240 pp., illus.* Many a Green Isle, by Judy Tudor. *Pacific Publications (Sydney), $3.92; 256 pp., illus.*

Here is one of the world's great panoramas of islands: Australia, the island continent (practically identical in size with the continental United States); New Zealand with its fiords and snow-capped mountains; New Guinea, the largest tropical island in the world; and some of the many thousands of volcanic peaks, coral atolls, and continental remnants that stud the Pacific Ocean. This authoritatively informative and beautifully illustrated book is the latest in "The Continents We Live On" series, so felicitously conceived and published by Random House. As the title page informs us, it is "a natural history." Fortunately for the reader, whether casual or scientific, the author, Allen Keast, has long been one of the Pacific area's finest naturalists. Through his eyes, and with the aid of a meticulously chosen group of pictures, we see quokkas and koalas, echidnas and platypuses, bowerbirds and kookaburras, numbats, wombats, and giant fruit bats, golden wattles and snow gums, penguins and seals, grass trees, kauri pines, and tree ferns, petrels and albatrosses, tree-climbing kangaroos, kakapos, keas, and cuscuses. We have, then, a book that is at once a delight to browse through and a valuable reference source. The use of color photographs is more than liberal, the quality of the black-and-white pictures is high, sectional relief maps keep the reader well oriented (a scale with each map would have been useful), scientific names are given in addition to common names, and there is an index. There are many more species of *Rhododendron* than the 48 species given (L.J. Brass alone has discovered more than this number), but mistakes like this are understandable.

The residents of Melbourne, Sydney, Adelaide, and Brisbane would have visitors believe that their famous coastal cities and surfing beaches *are* Australia. But urban Australians are now finding the fabulous "outback" that the overland explorers, pastoralists, graziers, and naturalists have been praising for generations. They listen with awakened interest to the verse of "Banjo" Paterson, a famous Australian balladeer:

> The wattles are in bloom,
> The breezes greet us as they pass
> With honey-sweet perfume;
> The parakeets go screaming by
> With flash of golden wing;
> And from the swamp the wild
> ducks cry.

As Alan Moorehead in his Foreword so aptly points out "... Australia is not a country that reveals itself very easily or dramatically.... You must wait and listen quietly . . . and then, little by little, an awareness of another world which is antediluvian, shy, infinitely subtle and sometimes a little sad, begins to penetrate the mind. . . . It i the quietness and stillness of the land that is so intriguing once you get use to it. Nowhere else in the world ca I remember this intense quality of timelessness...." As one who has for nearl twenty years "commuted" to Australi I can appreciate the truth of this gentl instruction. With this admonition b Moorehead, and with Keast as a guid to the initially bewildering diversity o unique flora and fauna, the visitor ca see, with patience and intelligent planning of his days (and nights, for man animals are nocturnal), many facets o the life of this isolated continent and o the islands beyond.

The Oxford Book of Flowerless Plants

By F. H. Brightman, *illustrated by* B. E. Nicholson. A companion book to *The Oxford Book of Wild Flowers,* this volume enables the user to identify the common seaweeds, fungi, mosses, lichens, and ferns in Britain. There are 96 pages in full color with the relevant text on the opposite page; at the end of the book there is a section on classification, reproduction, and growth. The book is arranged in an ecological pattern, making identification especially easy.
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Man does not live by landscape alone (although this would be open to debate in parts of Australia and on many of the Pacific islands!). Of late, his appreciation of the land and sea has become more sophisticated as he begins to look beyond the facies of the macrohabitats, and to fathom the intricacies of the many interlocking webs of life.

A Continent in Danger is more than a dramatic, interest-catching title; it is a simple statement of fact about Australia. Serventy's main concern is the future of wildlife in his country, but basically this is the story of habitats, many of which are today threatened with partial or complete destruction. In the twentieth century, man with his advanced technology is an uncertain and unpredictable neighbor in the natural world. Population and economic pressures dictate constant physical and chemical attack on the land. Man has still to relearn the lesson of many of his primitive forebears who lived in a reasonable balance with nature. And in the meantime he is losing or destroying irreplaceable plants and animals that constitute his heritage.

Serventy introduces his readers to the Australian fauna with brief descriptions of the monotremes, or egg-laying mammals, the famed marsupials, the native bats, rodents, reptiles, birds, and marine mammals. Many of these animals are shown in striking color and black-and-white photographs. But this book is much more than a faunal introduction. We learn which animals are endangered, and are given a truthful picture of the circumstances leading up to the present critical situation. No punches are pulled, and herein lies one of the great virtues of Serventy's writing. He gives an admirable summing-up of the conservation picture as it exists today in Australia.

Another strength of this volume is the detailed reference to the studies of biologists who are not only working on the life histories of native animals but who are also assessing and surveying the impact of man and his domestic stock (and introduced exotics) on the land and on the indigenous fauna and flora. J. H. Calaby, for example, has just published one of the most important papers ever written in this field in Australia. After having completed a field survey of the mammals in a 1,500-square-mile district of northeastern New South Wales, Calaby states, "It is of considerable significance to mammal conservation in Australia that such a rich and varied fauna [45 indigenous species] can still be found in an area with a long history of European economic exploitation, and there is no doubt that this situation is largely accounted for by the combination of State Forests and the local form of management of

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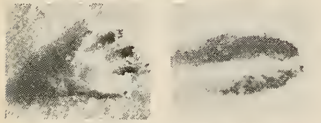

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private and leasehold land for beef production." Calaby's study and similar ones made on other continents prove that man and a considerable portion of the native fauna can live side by side if intelligent attention is paid to proper land use. Serventy outlines such a plan for action; he pleads for the preservation *now* of large and small tracts of natural bushland. He is a practical optimist: "We must face the opposition, not with abuse but with reasoned argument. But with passion too, because we believe that in the realm of nature lies sanity and refreshment for all. Our aim must be to convert, to educate, until all can reach the stage of sophistication where scenery, animals and plants are an essential part of living, of true recreation."

Judy Tudor has long been my favorite writer on the Pacific scene. No more honest, witty, and penetrating writer has so deftly chronicled the often strange and tangled events of the South Pacific islands. Keast has introduced us to the physical aspects of these varied islands. One will find no natural history in *Many a Green Isle*, but Mrs. Tudor lays bare man and nation and the political and economic motivation behind the events of recent years in the Pacific. In this volume, New Guinea, Fiji, French Polynesia, and the Cook Islands receive the major share of her attention. This book is required and delightful reading.

Hobart M. Van Deusen is the Assistant Curator, Archbold Collections, at The American Museum of Natural History.

A Draught of Fishes, by F. D. Ommanney. *Thomas Y. Crowell, $6.95; 254 pp., illus.*

Each year commercial fishermen catch between fifty and sixty million tons of fish, more than two-thirds of which is eaten by man. The most serious deficiency in the world's diet today is in its animal protein food—a component that in most places can be provided economically only by the sea. And so the search for new fisheries goes on, especially around those undeveloped countries where, as it happens, the lack of animal protein is most acute and marine fisheries are least well developed. Dr. Ommanney knows well the frustrating trials and tribulations that accompany this kind of economic proselytism. Finding exploitable stocks of fish is less than half the battle; tradition and impecuniosity are the real adversaries to be overcome. As officer in charge of exploratory fishing in the Indian Ocean and the western Pacific, the author had plenty of opportunity to see a variety of fishes and men in action, and he recounts his adventures and misadventures with verve and equanimity.

Interspersed among these vivid accounts of commercial fishing around the world is information on many aspects of the natural history of fishes. Some, such as schooling, feeding, migrations, and shark behavior, are of obvious importance to fishermen; others—protective coloration, pain and sleep in fishes, and deep-sea life—are of perennial interest to the layman. This blending of personal experience, natural history, and practical fishery problems makes *A Draught of Fishes* different from any of the other popular books on fish. Dr. Ommanney is to be congratulated on the skill with which he has made his volume into a sort of popular primer on up-to-date fishery biology without any textbook overtones.

James W. Atz
The American Museum

Shell Collecting: An Illustrated History, by S. Peter Dance. *University of California Press, $10.00; 344 pp., illus.*

Many of the reasons for today's spectacular rise in the popularity of conchology are found in this charming and detailed history of shell collecting from the pre-Christian era to the twentieth century. Known to the French as *La Belle Science* and to the English as the Queen of the Natural Sciences, the study of shells, as well as the people associated with the hobby, is entertainingly dealt with by the author.

The excitement of the chase is in the accounts of the voyages of Captain Cook, Sir Joseph Banks, and Captain William Bligh, all of whom were shell collectors. Rare and beautiful shells reached European markets during the eighteenth and nineteenth centuries, and many fabulous public auctions were held in London, Amsterdam, and Paris. Some cones and cowries fetched sums exceeding a thousand dollars.

Most famous of the lady collectors was the second Duchess of Portland (1714-1785), who amassed a huge collection, was known to have breakfast occasionally with King George III, and who finally ran herself into debt because of her social and shell-collecting excesses. Dean of collectors was Hugh Cuming (1791-1865), who brought back thousands of new species from the South Seas and Philippines, and who was unique in having personally picked up two live Glory-of-the-Sea cones.

The thirty-five plates in this book contain portraits of sixteen well-known European collectors, such as Martin Lister (1638-1712), Arthur Adams (1820-1878), and James Melvill (1845-1929). Photographs of some of the choice specimens found today in the British Museum show the beauty o

ıch species as the Imperial Harp, List-
r's Conch, and the Prince Cowrie. An
ppendix lists the shell collections of
ientific importance and their present
cations. Mr. Dance has done an admi-
ıble job of condensing and document-
ıg a wealth of historical information.

R. TUCKER ABBOTT
Academy of Natural Sciences of Philadelphia

HE LIFE OF THE FOREST, by Jack Mc-
ormick. *McGraw-Hill Book Co.,*
4.95; 232 pp., illus. THE OLYMPIC
AIN FOREST, by Ruth Kirk and Johsel
amkung. *University of Washington*
ress, $6.95; 86 pp., illus.

THE first of these books, a recent
title in McGraw-Hill's "Our Living
'orld of Nature" series, is particu-
rly suited for supplemental or as-
gned reading at the high school level,
ıt it is also readable coverage of the
ıbject for almost anyone. The book's
ope is North America north of
exico. The forest community as a
ynamic ecotone is discussed at length;
ere is a section on the effect of the
asons on various forms of life and
ıe on the major forest region, as well
a miscellany of information in an
pendix, a short but useful glossary,
d an index. Color is used abundantly
d usually well. The printing is good
d the book, being well bound in
ong boards, will withstand hard use.

A feature that appeals to me are
ose diagrams that show seasonal
anges in the duration of daylight, the
atomy of a tree, and forest products.
nong the outstanding full-page color
otographs are a drumming grouse,
innamon-phase black bear, sequoias,
d the Olympic Rain Forest.

In planning a book having textbook
vor, if the question were to arise
ıether to fill a spot with something
inly colorful (to increase color-im-
ct on user or buyer?) or something
h fewer reds (but which would
d to the information-impact), I
uld prefer the latter. For example,
book has a double-page spread of
umn in Vermont and, farther on,
other of autumn in the Great
okies. Both convey much the same
ormation—the fall season within the
stern Forest Region. A map shows
Boreal (coniferous) Forest Region
be much bigger than the Eastern.
re information coverage—although
er square inches of vivid color—
ıld have been included if, instead of
umn in the Smokies, there had been
ne panorama of the Boreal Forest.

Again, as regards this type of book,
re is probably no point in labeling
ch illustrations are "straight" shots,
ch are of unconfined tame animals
aving "naturally," which are of ani-

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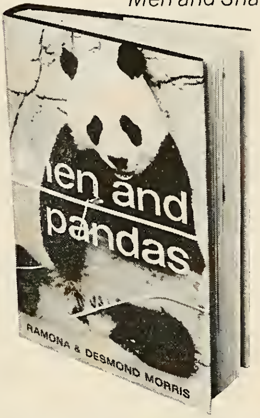

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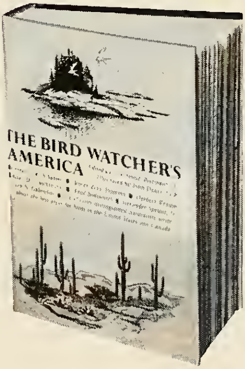

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mals subject to physical restraint (such as being confined in cages), and which are thoroughly contrived. (There are some readers who care about these matters, although many could not care less.) There are numerous fine pictures that fall in the first category. Probably the mountain lion burying a carcass and the fox with a dead rabbit are representatives of the second. The fisher is an example of the third. As to the fourth, what is the statistical likelihood of a photographer getting—in focus, in color, with motion stopped—a "straight" shot of a lynx pouncing on a jumping hare? Even if—and it is indeed a big IF—the photographer did succeed in beating the overwhelming statistical odds against him, the result appears to be phony. A photo showing where a lynx had fed on its natural prey is not difficult to take and, although less theatrical, conveys the same biological information just as effectively.

The Olympic Rain Forest is a different sort of book. It contains a well-written essay on the nature and beauty of this largely still-unspoiled northwestern wilderness and the impact on it of man (with hope that this will not increase). A forest that grows where precipitation is heavy and relatively constant is not a particularly colorful subject. There are, however, eight pages of color in the book. The first of these, featuring a single large spruce, conveys a hint of the physical dimensions of this unique forest. The numerous fine black-and-white photographs are dark; a reader unfamiliar with rain forests might think that they were overinked in printing, but they are a faithful rendering of a cloudy, wet environment where the light that does succeed in penetrating is absorbed more than reflected. These pictures are mostly close-ups, as of ferns and of raindrops on leaves, and others are of middle distance. A few large photos of a panoramic nature, which would have conveyed a feeling of the over-all grandeur of these forested slopes, would have been welcome.

RALPH S. PALMER
University of the State of New York

THE TERRITORIAL IMPERATIVE, by Robert Ardrey. *Atheneum, $6.95; 390 pp., illus.*

It is now fashionable for writers to use researches into animal behavior as the subject of major treatises directed toward the interpretation of human behavior. Scientists frequently are enthusiastic supporters of such writers, but unfortunately they cannot anticipate the disastrous misuse of their work, so clearly exemplified by Robert Ardrey in *The Territorial Imperative.* Ardrey has grabbed onto behavioral

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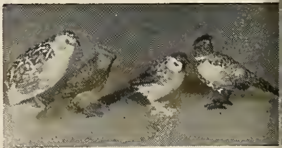

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idies and theories (mainly those of e ethologists) and has exploited them order to convince himself and his aders that man is instinctively aggres- e, evil, cruel, and a killer by nature nan's behavior being dictated by his olutionary history, in particular by frahuman animals that show terri- ial and aggressive behavior. Implicit his use of the concept of territoriality aggression. In a way, the author's se of conscience in his manipulation research findings is the fault of the entists. We have not sufficiently ed- ated the lay public, particularly men e Ardrey, to understand and to re- ect the limits of scientific discovery. d so because of naïveté and lack of owledge, Ardrey can justify his ses in selecting researches on terri- iality and other behavior he consid- pertinent, such as homing, to sup- t his arguments about man's hostile l aggressive biological nature. He ries out his theme by citing case dies of researches on the territorial avior of a number of birds and mmals during the breeding season. descriptions are beautiful; they lucidly, using eloquent phrases liantly conjured to infer the human- c qualities of his non-human sub- s. For example, he glibly compares simple and stereotyped behavior terns of the planarian worm to the nplex and highly plastic behavior of n. After he describes the reaction of anarian worm to a familiar feeding und, he immediately moves on to n's feeding preferences and sums up argument with what studies of narian worms can tell us about iet agriculture. He cites researches ticklebacks, comparing their fight- with that of prize fighters and small s. The courtship of bowerbirds is ted to human courtship, and terri- ality in gulls is the acknowledge- t of "man's demand of privacy and e." When an animal is non-terri- al, its survival is threatened. Ard- s excuse for the decline of the npanzee is that they are non-terri- al, consequently non-aggressive, therefore unable to retain any hold in their natural environment. ements such as these show that the or has shallow comprehension of many-faceted and highly complex actions of animals with environ- t. There are many errors in inter- ation of researches, although the arches themselves may be presented rately. His biggest and most seri- problem is his high jumping, when eaps from studies of animals that limited behavioral repertoire to nalysis of man, whose behavioral rtoire is vast, whose behavioral icity has not reached its fullest ntial, and whose behavior is a result not only of biological inheritance but also of his life experience and his cultural heritage. Ardrey cannot equate the behavior of man with the behavior of infrahuman animals. He is unaware of an important concept in biology, the concept of levels of integration, succinctly stated by Novikoff in 1945, "new levels of complexity are superimposed on the individual units by the organization of these units into a single system. What were wholes on one level, become parts on a higher one. Each level of organization possesses unique properties of structure and behavior which, though dependent on the properties of the constituent elements, appear only when these elements are combined in the new system. Knowledge of the [behavioral] laws of the lower level is necessary for a full understanding of the higher level, yet the unique properties of the higher level cannot be predicted, a priori, from the [behavioral] laws of the lower level." Had Ardrey studied animals in terms of levels of organization, he would have been unable to write this book.

It's a pity that the end result of this talented writer's personal tour de force is not a real contribution toward the popularization and recognition of the importance of behavioral science in our lives. Scientists need men like Ardrey on their side. With his brilliant, persuasive style he could serve mankind better by showing that researches can give hope instead of despair.

EVELYN SHAW
The American Museum

New Guides

THE OXFORD BOOK OF FLOWERLESS PLANTS, by F. H. Brightman. Oxford University Press, $10.00; 208 pp., illus.

A FIELD GUIDE TO WESTERN REPTILES AND AMPHIBIANS, by Robert C. Stebbins. Houghton Mifflin Co., $4.95; 279 pp., illus.

THE WILD FLOWERS OF CALIFORNIA, by Mary Elizabeth Parsons. Dover Publications, $2.25; 425 pp., illus.

SEASHORE PLANTS OF SOUTHERN CALIFORNIA and SEASHORE PLANTS OF NORTHERN CALIFORNIA, by E. Yale Dawson. University of California Press, $1.75 each; 101 and 103 pp. respectively, illus.

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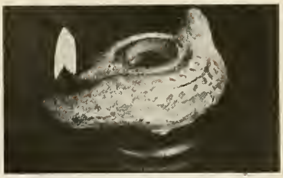
63—AMNH



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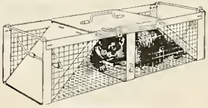

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MAN, CULTURE, AND ANIMALS: THE ROLE OF ANIMALS IN HUMAN ECOLOGICAL ADJUSTMENTS. A. Leeds and A. Vayda. American Association for the Advancement of Science, Washington, 1965.

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DEATH'S HEAD, CHERUB, URN AND WILLOW

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OVER THEIR DEAD BODIES: YANKEE EPITAPHS AND HISTORY. T. C. Mann and J. Greene. Stephen Greene Press, Brattleboro, 1962.

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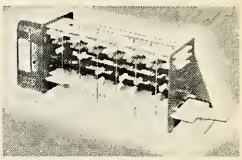

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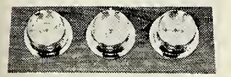

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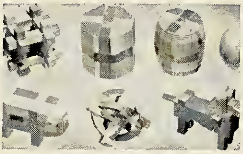

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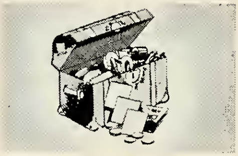

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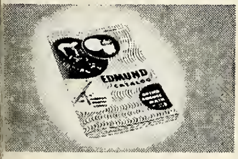

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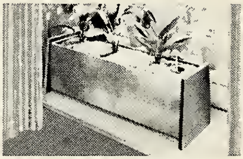

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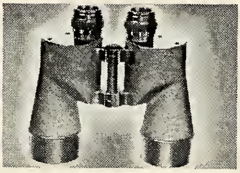

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COVER: This is a photograph of a rarity indeed—one of the finds described
Carlo T. E. Gay in "Oldest Paintings of the New World." The scene depicts wh
was probably an ancient Olmec ritual (for a closer look at the two participan
see page 29). When we asked the author how he recorded the art deep in a Me
can cave, he smiled broadly and replied, "With a steady hand." He lacked su
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kerosene lanterns. So, for each shot, he opened his Rolleiflex to its wid
aperture, took a deep breath, and exposed the Kodacolor film for two secon

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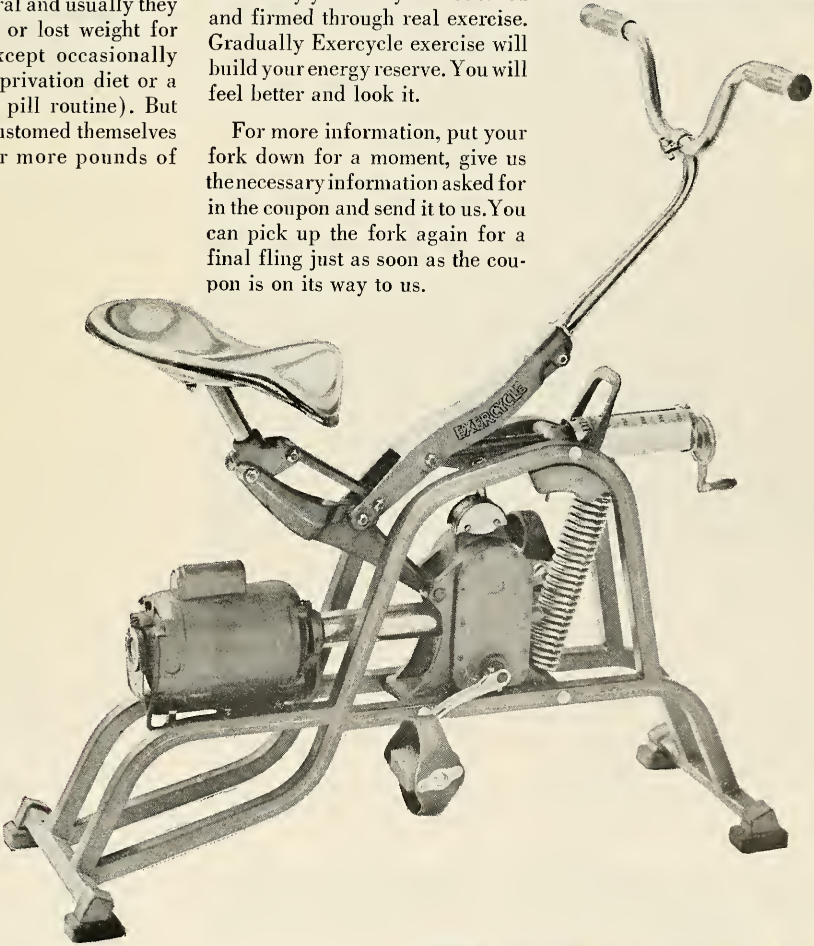

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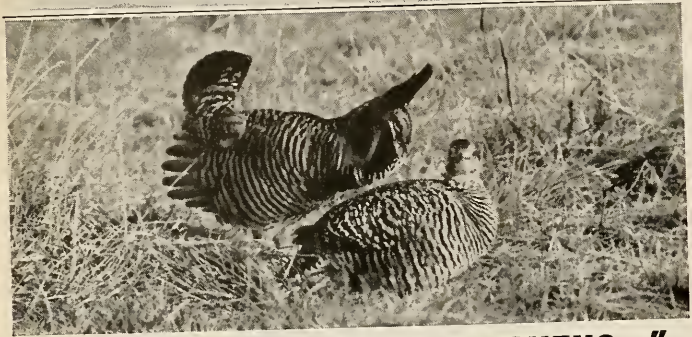

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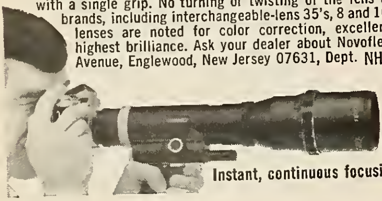

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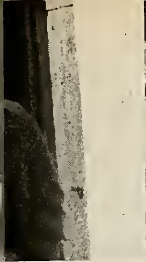
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Robert E. Morsberger

ıte University of New York at Buf- o and is a Research Associate in the partment of Herpetology at The ıerican Museum. He specializes in mechanics, particularly the func- nal anatomy of reptiles. For this rk he combines his background in chanical engineering (B. Mech. g., N.Y.U.; M.S. Mech. Eng., Colum-) with his knowledge of evolution- biology (Ph.D., Biology, Harvard). Gans has recently been a visiting earcher at the Universities of Lei- ı, Tel Aviv, and Bristol.

Villem Jan Tijmens is presently king at the Brooklyn Botanic Gar- on a fellowship. Born and educated he Netherlands, Mr. Tijmens stud- horticulture there, and later during s to England and the United States. ce 1958 he has been a resident of ith Africa where he is now a curator he Botanic Gardens of the Univer- of Stellenbosch. He is a member, has been chairman, of the Institute Parks Administration of South ica. Mr. Tijmens has made biolog- surveys of the Hottentots Holland ıntains by helicopter.

Villiam N. Tavolga is an ichthyol- st specializing in the embryology of es, specifically their sound produc- , about which he writes in "Noisy rus of the Sea." A Research Asso- e in Animal Behavior at The Ameri- Museum, Dr. Tavolga is also Pro- or of Biology at The City College ıe City University of New York. He done field work at the Lerner Marine Laboratory at Bimini in the Bahamas and has written numerous books, articles, and reviews. The second volume of his book *Marine Bio-Acoustics* is to be published this year.

Carlo T. E. Gay was born in Italy and holds a diploma in Amaric language from the Institute of Oriental Language of Naples as well as a doctorate in economics from the University of Naples. For 21 years he was affiliated with an Italian steel company. In 1961, however, he retired as an executive of the company's North American subsidiaries to co-ordinate and pursue research that was begun in 1956 on Olmec culture in Mexico. Last year Dr. Gay wrote an article on Olmec rock carvings for Natural History; this month he presents the "Oldest Paintings of the New World."

Robert E. Morsberger is currently Associate Professor of American Thought and Language at Michigan State University, and has recently returned from two years at the University of Nigeria. A member of the MSU/AID advisory team there, Dr. Morsberger served as acting head of the English Department and concurrently headed a committee to establish a University of Nigeria Press. Dr. Morsberger has been a national park ranger and is the author of several books, among them *James Thurber* and *How to Improve Your Verbal Skills;* he is presently working on a series of historical narratives of nineteenth-century American adventures on the high seas.

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THE SNOUTERS

by Harald Stümpke

Among mammals the order Rhinogradentia, commonly called snouters, holds a unique position, to be explained first of all by the fact that these most oddly constructed animals have been discovered only very recently. That hitherto they have remained unknown to science is because their native land, the South Sea archipelago Hi-yi-yi, was not discovered until the year 1941 and even then was only visited for the first time by civilized Europeans through a rare chance connected with the war in the Pacific. In addition, this group of animals has particular significance because among them are found principles of structure, modes of behavior, and ecological types that are unknown elsewhere, not just among mammals but among vertebrates in general.

Discovery of the archipelago is to be credited to the Swede Einar Pettersson-Skämtkvist who, after escaping from Japanese imprisonment, eventually landed on the island Hydud-dye-fee.

The natives found by Skämtkvist on his arrival in 1941 called themselves Hooakha-Hutchi. They have since become extinct, but according to Skämtkvist seem to have been Polynesian-Europoid. It was impossible to investigate their language because a head cold introduced by the discoverer destroyed these children of nature inside of a few months. Despite the presence of humankind this extraordinary archipelagic world of organisms was preserved, which is most astounding, because almost all the terrestrial animals would have been destroyed if they had been hunted more intensively by the inhabitants.

The snouters are—as the name indicates—all distinguished by the extraordinarily developed snout, which may be present singly, or in a greater number. The latter condition is unique among the vertebrates. Anatomical investigations have shown that in the polyrhine species the nasal rudiment is cleft at an early embryonic stage, so that the rudimentary individual nostrils that develop from it have a holorhinous differentiation—each forms a complete snout. Together with the early polyrhinalization there occur numerous extensive alterations of the entire structural plan of the head.

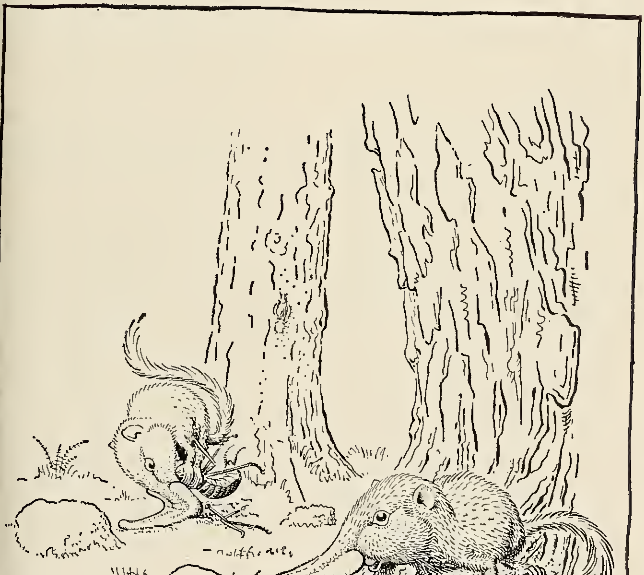
Inasmuch as in these rhinograde animals—with the exception of the genus *Archirhinos* (a primitive snouter)—the *nasarium* serves as a means of progression, the other appendages have lost their locomotor functions. Correspondingly, the posterior appendages are mostly more or less reduced, while the anterior appendages have been modified as grasping organs for holding the food or as little hands for grooming.

Whereas, then, the paired appendages are less impressive features of the general organization of the snouters, the tail of the animal occupies an outstanding place, and in its construction has developed manifold and altogether aberrant types. Thus one finds not only coiling tails and lasso-like tails, but also in the sclerorhines (the Proboscipedes) the tail serves the more primitive forms for jumping and the more advanced ones as a grasping organ.

In most snouters the body is covered with a fairly uniform coat, in which no distinction can be made between underfur and guard hairs. At times the coloration of the coat is magnificent. Famous above all is the extraordinary luster of the pelt, caused by the special structure of the hair cortex. The bare spots—head, feet, tail. ears. combs of skin on the head and especially on the snout—are brightly colored at times.

The manner of feeding varies greatly among the different families, and even within the same family or genus. Yet this is hardly surprising when one recalls that, besides a single aquatic shrew, the snouters are the only mammals of the archipelago and have thus been able to take possession of all ecological niches. Most of the rhinograde animals, the average size of which is indeed small, eat insects. But in addition there are also herbivores—especially fructivorous species—and one predaceous genus. To be mentioned finally as particularly specialized forms are the plankton feeders that live in fresh water, and the burrowing forms, among which are the tiniest vertebrates known.

Among the more perplexing developments of the Second World War is the unforeseen discovery of an outlandish order of mammals



'rimitive Snouters *Archirhinos haeckelii*

Thus the snout is altogether unadapted to function as a locomotor organ and nerely serves the animal as a support when it is devouring captured prey."

The Primitive Snouter

The only living representative of the primitive snouters is *Archirhinos haeckelii* (Haeckel's primitive snouter). It still walks on four legs like other mammals, and still lacks a highly differentiated *nasarium*. Thus the snout is altogether unadapted to function as a locomotor organ and merely serves the animal as a support when it is devouring captured prey (*see drawing left, animal in background*). The habits of the primitive snouter resemble in many respects those of a shrew: whereas in the daytime it sleeps in a simple nest under roots, at twilight it emerges in search of food. Then the mouse-sized creature with its thick head and enormous snout may be seen running about and chasing the huge cockroaches, large numbers of which often are gathered around the banana-shaped berries that have fallen at the foot of the *Wisoleka* trunks.

When it has caught an insect, the primitive snouter falls swiftly on its snout, the margins of which spread quickly apart to form a broad supporting surface. Viscous nasal mucus provides a firm hold of the ground. And now the greedy beast brings the food very rapidly to its mouth with all four feet. From afar the feasting creatures betray their presence with loud, chattering squeaks. Once the meal is done they reverse from their headstand just as quickly, the margins of the snout are rolled inward again, and the chase is

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resumed. Little is known as yet about the reproduction of these animals, as they occur only in the inaccessible mountain forests of Hy-dud-dye-fee.

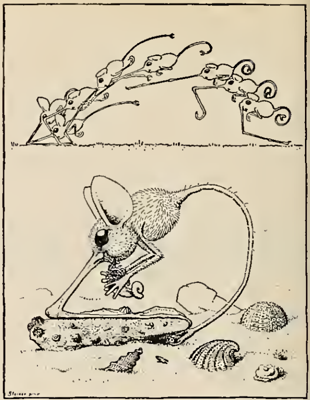
The Snout Leaper

There are several groups of snout leapers, one of which, the Hopsorhinidae, lives on the ground. Their hind limbs are vestigial and no longer visible externally; the torso is firmly encapsulated. The snout has undergone a division into three segments. The forelimbs are mobile, grasping organs. The tail no longer subserves progression but is used for securing food, which consists primarily of amphipods, isopods, and little hermit crabs from the high-tide level. In consequence, the supporting caudal soleplate has been modified to constitute a pair of grasping tongs, the claws of which have been formed from modified or fused hairs, and in cross section they present a histological picture resembling that of rhinoceros horn tissue. With this tail the snout leapers are most adept at pulling their prey out of the narrowest clefts and hiding places. Their leaps—which at ordinary speeds of progression cover about one-and-a-half body lengths but which, when fleeing or pursuing a mate or rival, may be ten times as great—regularly are rearward (*drawing top of page*). The jump can be guided to some extent by slight movements of the huge ears.

The snout leapers belong to the most frequently encountered Rhinogradentia. Everywhere on the shore they inhabit the stony coral patches, the sands of the flood plains, or the volcanic or sedimentary gravel beds. It seems that the stronger males maintain small harems and drive off weaker males. However, the differences between the sexes are so slight that field observation has not yet permitted analysis of details of behavior within the packs.

The Earwing

The earwing (*Otopteryx volitans*), the only representative of its genus, is by its structure readily to be recognized as a modified hopsorhine. Actually this animal is distinguished from its cousins only by the enormous size of the ears and the differentiation and strengthening, in correlation with its flight ability, of the musculature of the external ear. The one other difference, its vestigial tail, is a structural detail of little import. In all other respects, *Otopteryx* is a typical hopsorhine.



Snout Leapers *Hopsorhinus aureus*

"Their leaps—which at ordinary speeds of progression cover about one-and-a-half body lengths but which, when fleeing or pursuing a mate or rival, may be ten times as great—regularly are rearward. The jump can be guided to some extent by slight movements of the huge ears."

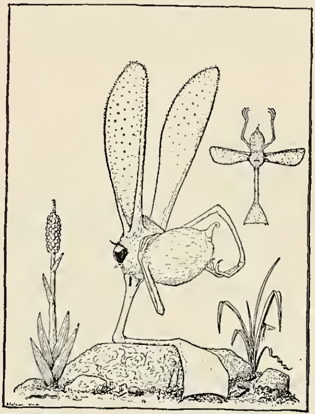
In *Otopteryx* the iridescence of the pelt attains its highest expression, so that the animals can be compared only with tropical butterflies or hummingbirds. Hence it is a magnificent sight when with rapid strokes of its ears the animal dashes close above the flower-bedecked mountain meadows in pursuit of dragonflies or of Hexaptera, or climbs abruptly aloft into the blue sky, there to wheel in play with others of its kind. Most enchanting of all are the newborn—still scarcely able to hold their ears out—that stagger about the flowers, on the search for small insects. The strangest thing about all this is that *Otopteryx* flies backward, although this too is comprehensible when one recalls that the flight of *Otopteryx* is derived from the gliding of the hopsorhines, which leap backward.

Especially peculiar and characteristic is the takeoff and landing of the earwings. The animal, standing on its flexed snout, first "cocks" its ears (raises them vertically so that they touch one another), then flexes the deutonasal joint even more strongly, as in *Hopsorhinus*, after which the several phases ensue as in the latter, with the difference that the ap is more vertical. Shortly before e jump reaches peak height, the rs are powerfully depressed. The lly extended snout is spread wide the autonasal region, and the ani- al flies. These individual phases n of course be analyzed only by gh-speed photography.

The process of flight itself is ex- emely rich in variety: when an lept insect is being pursued, or ring playful flight maneuvers, eat distances are traversed at inding speed, with the ears beating interruptedly up and down at a te of about 10 strokes per second. uring searching flight, earbeats of ual frequency but of small ampli- de alternate with short periods of iding. Along the slopes, in the usu- y breezy island winds, *Otopteryx* so is able to soar at length. At all ents it does not often go high into e air, and for the most part re- ains at altitudes under 20 yards.

Its method of landing is peculiar, ing rendered difficult by the fact it the snout must perform in a uble capacity, both as a foot and as steering tail: if an earwing wishes come to earth, it mostly ap- oaches the landing place in a steep de, with the ears held somewhat rsad and nasad. When close above ground it suddenly adopts a ver- al stance with the hind end some- at elevated, which results in an rupt, temporarily upward arc dur- which the steering tail—the tip of snout—almost touches the earth. this position, in which the ears strongly arched, the animal des forward for yet a short stretch se above the ground, losing alti- e and velocity the while. Then it ldenly folds the nasal steering chanism together, curves the ut ventrad, and after elevating the s to their full extent lets itself le elastically onto the snout, which now is stretched far caudad. This phase of the alighting process in bears a great resemblance to sorhines landing after a leap.

The way in which *Otopteryx* has ved the problem of locomotion— m the morphological standpoint, most extraordinary solution—calls a comparison with the other fly- forms of the animal kingdom. h the exception of the Rhinogra- tia themselves, true fliers have ap- red only four times altogether: the insects, the flying reptiles, the birds, and the bats. Among these, the insects, whose organs of flight are supplementary additions not made at the expense of terrestrial locomotion, actually have found the most complete solution. The bipedal gait of birds likewise permits great mobility both on the ground and in the air, even though in actuality the wings were "stolen" from the mechanism for progression on land. Among the flying reptiles and the bats the power of flight arose at the cost of locomotion on foot; therefore the two groups were not and are not fully qualified to compete with the others just mentioned. But in *Otopteryx* now the situation is just as favorable as in insects; the ears are actually supplementary instruments of flight. Nonetheless, *Otopteryx*, with the high degree of limb reduction that preceded flight, has been derived from animals that were strongly specialized in a single direction—yet in their nasal "monopody" they are quite comparable to hopping birds. In any case *Otopteryx* enjoys a clear advantage over flying reptiles or bats, for it is a most skillful leaper, and the participation of the snout in flight has not limited its usefulness for terrestrial progression to the



Earwings *Otopteryx volitans*

"Hence it is a magnificent sight
when with rapid strokes of its ear
the anmial dashes close above
the flower-bedecked mountain meadow
in pursuit of dragonflies . . .
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into the blue sky, there to wheel
in play with others of its kind."

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same extent as has occurred with the anterior limbs of these other groups. Whether *Otopteryx* could hold its own in sharper competition with continental animals is questionable. At all events it has scarcely any enemies in the islands. Neither the indigenous Megaphone Birds nor the seabirds, which are numerous from time to time along the coast, can catch it in flight. In agreement with this is the fact that one rarely finds pregnant specimens. The period of gestation is at least as short as with the hopsorhines. Only a single fetus is carried at a time. It is suspected that the females bear two young per annum.

The earwings are not to be kept in captivity, because they remain too easily frightened, bruise the buttocks in their wild leaps and attempts at flight, and soon succumb to the infections that arise in the wounds.

The Miraculous Flower-faced Snouter

To the genus of the flower-faced snouters (*Corbulonasus*) belongs a whole series of the most beautiful Rhinogradentia that are known. All of them are distinguished by short, broad, petal-like snouts, set close about the mouth and supplied with a very simple epinasal and hyponasal musculature that permits the animals to clap together the tonically outspread snouts very rapidly whenever an insect settles in the oral field.

As a typical representative of the genus we choose the miraculous flower-faced snouter (*C. longicauda*), which lives colonially on Mitadina in the meadows of Ranunculaceae of the more elevated mountainous regions. Skämtkvist describes the sight of such colonies as the most beautiful thing he saw on Hi-yi-yi. The vividness of the colors and the luster of the snouts are said to be quite extraordinary, and the characteristic spectacle of the animals' swaying on their tails in the fresh sea breezes is enchanting. Evidently, what pleases us most in these curious creatures is, for the flower-seeking insects, nothing more than the presentation of hypereffective stimuli; in this sense too is to be interpreted the buttermilk-like odor that emanates from the open mouths of the lurking cephalanthids.

In addition to the *nasarium*, one of their striking features is the stiffened tail, which may be as much a
20 inches long. An interesting thin
is how the caudal, or tail, structur
changes as the animal grows: th
newly born animals, which alread
possess a fully developed *nasarium*
fall to the ground and climb up o
the stems of nearby flowers. Havin
reached the top, they bite off all th
buds, unfold the *nasarium,* and begi
to capture prey just as older spec
mens do. Their still soft tail is the
just about the length of the body an
differs in no respect from a norm
mammalian tail. But it prompt
grows in length, and in fact by mea
of elongation of the vertebrae. As th
intervertebral articulations ankylo
and the intervertebral sinews and li
aments also stiffen, the caudal mu
culature degenerates. The tip of t
tail bears a much cornified epith
lium that eventually forms a sort
pointed, plug-shaped horny cap.
soon as the tip of the tail reaches t
ground, the animal that has climb
up the plant stem starts to bore th
caudal plug into the ground. whi
within four to six days it penetrat
to a depth of as much as 6 inche
Then the animal lets go of the pla
stem and henceforth is supported
its own tail, which continues
lengthen. The degree of caudal exte
sion attained depends on the nut
tional state of the animal, a
proceeds more slowly when the latt
is well fed. An animal once firm
"planted" in this way can no long
move from its location, but sim
waits there for prey with folded ar
and open mouth. As mentioned, t
mental capacities are slight. Mati
takes place when it is windy: as t
specimens are blown back and fo
on their tails and come into conta
the desirous males take firm hold
the females. The period of gestati
is said to be but three weeks, and
total duration of life is estima
maximally at eight months. Gro
from birth to maturity requires p
haps two months; from birth to c
dal implantation 18 to 22 days.

EPILOGUE

Harald Stümpke's manuscript
waiting publication when it beca
known that, during secret tests
atomic explosions (about which e
the press had heard nothing), the
tire Hi-yi-yi Archipelago had b
annihilated through the oversigh

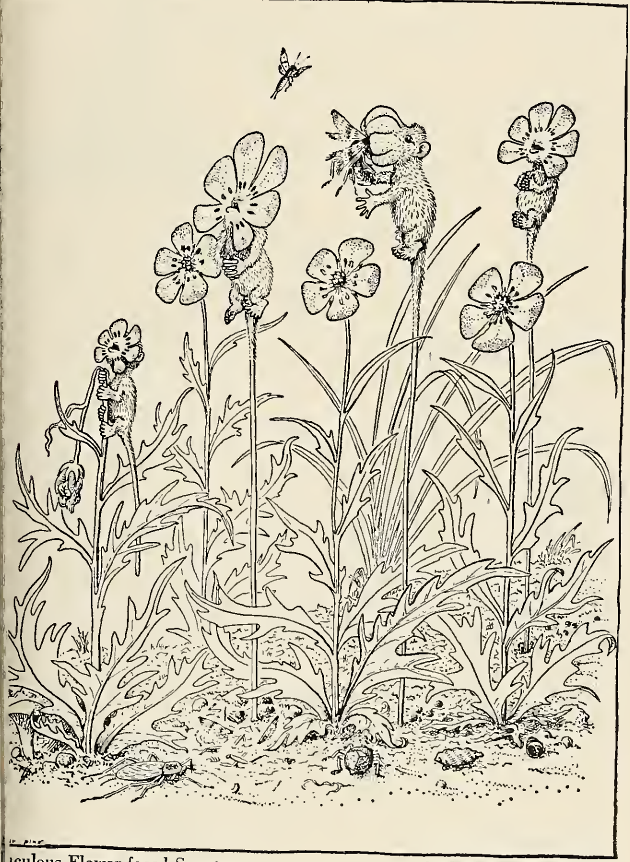
me subordinate. As a result of tec-
nic tensions that had not been
nticipated, all the islands sank be-
eath the sea when the burst was set
ff some 125 miles distant.

At the time in question, an inter-
tional commission for study of the
chipelago was in session on Mairú-
li. Among those present were most
the scientists named to work at
e newly created Darwin Institute
Hi-yi-yi, situated on the lovely
stern bay of the islands and
ntaining the irreplaceable photo-
aphic material, the various prep-
ations and observational and
perimental records that were to
ve formed the nucleus of a great,
mprehensive treatise concerning
archipelago and its geological, historical, zoological, and sociological peculiarities.

Thus it was most fortunate that, shortly before his last voyage, Stümpke had undertaken to compose a short exposition of the structure and habits of the Rhinogradentia. Toward preparation of drawings he had supplied me also with some material that he—one can only say, alas!—took back to Hi-yi-yi with him. Still it was in this way that at least a part of the lifework of this modest and deserving seeker after truth could be preserved as a balanced whole for science and for a broader audience, and with it the knowledge of a now vanished world.

Gerolf Steiner

Heidelberg, October, 1957



culous Flower-faced Snouter *Corbulonasus longicauda*

*vividness of the colors and the luster of the snouts
aid to be quite extraordinary, and the characteristic spectacle of
nimals' swaying on their tails in the fresh sea breezes is enchanting."*

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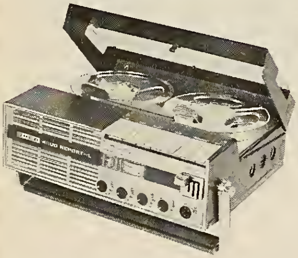

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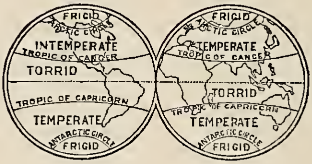


A Naturalist at Large

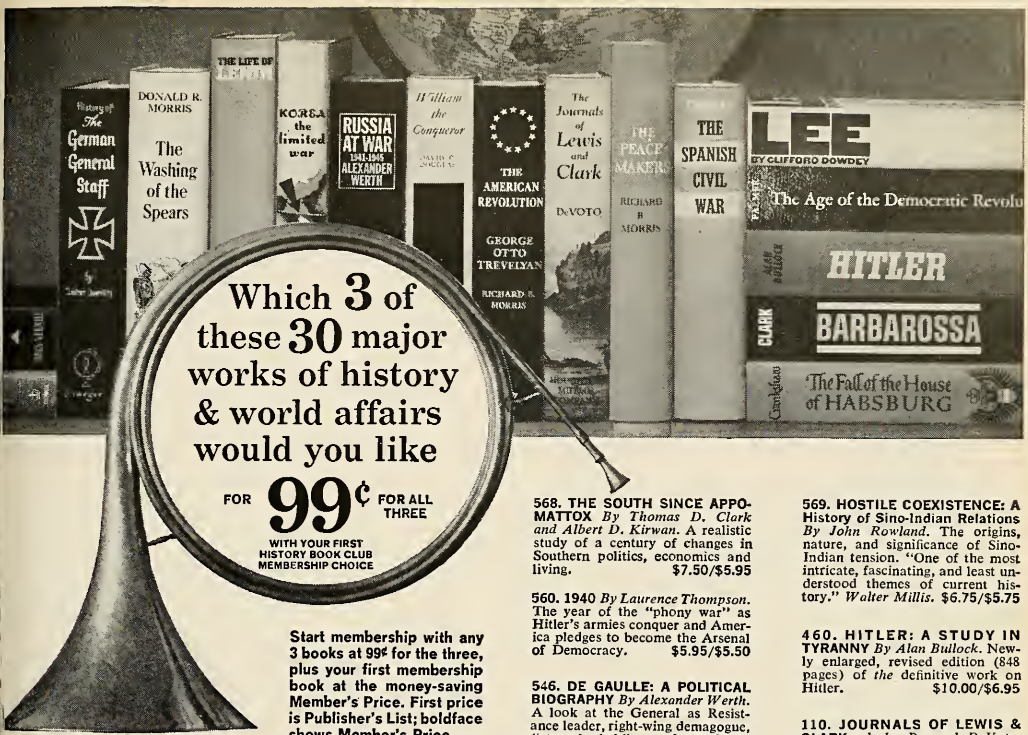
Aggression has become a common word these days. It has, of course, long been thrown about in discussions of international politics, and clinical psychologists tend to find aggressive impulses in everyone, however meek he may seem. But the word has now escaped from politics and psychology into general discussion, largely because of two widely read books published last year: Konrad Lorenz, *On Aggression;* and Robert Ardrey, *The Territorial Imperative.*

Both books are concerned with the possible (or probable) persistence of innate (instinctive) behavior patterns in the human animal, and attempt to explain the peculiar ability people have of being mean to one another, especially as expressed in that curious and uniquely human phenomenon called warfare. I reviewed each of the books in strongly favorable terms at the time of publication. I have read many other reviews since then and continued to think about the subject—and to talk about it—and I find it difficult to resist the chance to sound off again.

The critics have varied from enthusiasm to downright hostility, with literary figures tending toward enthusiasm, and scientists showing a whole spectrum of reactions—depending, I suppose, on the particular set of ideas to which they are committed. Scientists are not nearly as impersonal and impartial as they like to make out—after all, they are people, and they can be quite aggressive when their particular intellectual territories are invaded.

Both authors have oversimplifie and overstressed certain aspects o animal behavior in the effort to mak their points; each more or less admit this in the course of his book. Bu for some reason this seems to be necessary to make people listen. Rache Carson did the same thing, on a quit different subject, in *Silent Spring.* I she were still with us, I suspect n reader of NATURAL HISTORY woul quibble with her about this. The objectives of Lorenz and Ardrey seem to me valid: to bring the discussio of human nature out into the ope and to try to look at the biologic inheritance that is surely still with u The clinical psychologists have ha too much of a monopoly on this f a long time, probably because the are the most verbal of the scientis concerned. Or maybe because the are the most aggressive.

Evelyn Shaw took a dim view the Ardrey book in last month's iss of NATURAL HISTORY. And my goo friend Ted Schneirla wrote wh seems to me a somewhat grump review of Lorenz in the Decembe 1966, issue. I hope I can still ca him my good friend because I great admire his work. But I also great admire the work of Lorenz, Tinbe gen, and some of the other peop who call themselves "ethologist (but why did they have to inve such a word; why not just stu animal behavior?). Sometimes, an outsider, I think the differenc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among the various schools of psychological thought are more a matter of words than of ideas—but then, words seem to cause a great deal of human misunderstanding.

As for Robert Ardrey, he has been a successful dramatist. What business does he have messing around with animal behavior and the human condition? I think he makes his own best defense. The human condition is a matter of concern for all of us, and we had all better think about it, talk about it, and—if we can—write about it. I am astonished at Ardrey's mastery of the relevant biological literature. I don't think anyone can quarrel with the animal-reporting in either book: the difficulties start when we turn from other animals to the behavior of people.

Our anatomy and physiology is not much different from that of other mammals, except for our much-touted big brain. If anatomy and physiology have persisted through the course of evolution from protohominid to hominid, presumably behavioral characteristics have persisted also. But they have become deeply buried by the tremendously increased importance of teaching and learning ("extrasomatic inheritance"), which result in what the anthropologists call culture. Digging through this cultural overlay to the biological animal underneath has so far met with almost total defeat. But if we are to gain any understanding of ourselves, we must keep on trying, and I salute Lorenz and Ardrey for their attempts.

On Aggression seems to me misleading as a title for the Lorenz book. I am told that he chose it himself and carefully checked the English version, so that Marjorie Wilson, the translator, cannot be blamed for the terminology. The German title is *Das Sogenannte Böse.* I don't think there is any close English equivalent for *Böse*—it is a sort of blend of anger, maliciousness, evil. But the "so-called" gives a much-needed biological perspective; though I must admit that "So-called Maliciousness" or even "So-called Aggression" would make a lousy book title.

The living world of our planet forms an ongoing system that has been working on the same principles for some hundreds of millions of years now. Life as we know it comes in packages that we call "individuals," and the packages are of many different kinds, "species." The system includes mechanisms for such things as the transference of energy and the cycling of materials, for the diversification and development of species, and also for the distribution, spacing, and maintenance of interrelationships among the packages. Some relationships we call antagonistic, some co-operative—but to my mind this reflects, not the way nature works, but the way we think. In his book, Lorenz has dedicated himself to showing the adaptive value of one kind of interrelationship among individuals of the same species—one of the relationships that we call antagonistic, that we see as aggressive behavior on the part of one individual to another. The trouble is that when we call this aggression, we think of it as bad; but if such behavior promotes the survival of the species—and much of Lorenz's book is devoted to showing this—adjectives like "bad" or "good" are irrelevant.

It is another matter when we turn o *Homo sapiens*. Our peculiarity is hat we frequently kill one another n the course of our antagonisms, omething that is rare and accidental n nature, although common enough when animals are confined in cages. Lorenz points out that ordinarily, in he course of biological evolution, nhibiting behavior develops along with dangerous weapons like teeth nd claws. In the rapid course of uman cultural change, weapons ave outpaced behavioral controls. ut if there is any simple biological mpulse underlying aggressive beavior in man, it has become warped nto a tremendous variety of shapes uring our cultural history.

I have come to think that "aggres-on," when used with reference to an, is a sort of wastebasket word to which we have dumped all sorts garbage. What kind of shared nimal behavior could explain one runk slugging another in a bar, a an impersonally pulling a lever to emolish a city, a thief knifing his ctim in the back, the burning of a eretic, the massacre of Syrians, Inans, Christians, or Jews? These ings are the consequences of cultral attitudes, like those of the Yamamö Indians described by Napoon Chagnon in the January issue of NATURAL HISTORY. If there is, behind all of this, some animal impulse gone berserk, it has proliferated into an amazing variety of forms.

I agree with Lorenz that it would be a great help if we could learn to take ourselves less seriously. But I am not sure that either of us knows how to accomplish this. I know I don't. I keep trying, but it is difficult in the face of the headlines in the daily paper.

Curiously, I have also recently come to think that the word "territory" as used by biologists may cover a variety of quite different things. I say "curiously" because I have been lecturing, observing, and writing about it for years without any qualms. It seems simple: an area defended by an individual or group against intrusion by other individuals of the same species. If an animal stays in the same region, but does not defend against intrusion, the area is called a "home range."

The idea of territory first gained general currency as a consequence of a little book called *Territory in Bird Life*, published in 1920 by an amateur British ornithologist, Eliot Howard. Territorial behavior since then has been studied intensively by many people, observing many kinds of animals in different parts of the world. The ornithologist Margaret Nice, in an article published in the *American Midland Naturalist* in 1941, distinguished six kinds of territory among birds: mating, nesting, and feeding ground; mating and nesting area but not the whole feeding ground; mating station only; immediate surroundings of nest only; winter territories; and roosting points. Are these all the consequence of some single, basic drive? It seems to me possible that the lek behavior of male grouse described by Paul Johnsgard in the March issue of this magazine may be a different kind of phenomenon from the behavior of a band of howler monkeys defending their patch of forest from intrusion by other bands.

The situation among our relatives, the primates, is especially puzzling, which is no help when one attempts to decide whether there is any basic territorial drive left in the human animal. Gibbon families are strictly territorial. George Schaller (*The Mountain Gorilla*) found that a

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gorilla band tended to stay in a particular home range, but did not defend this from intrusion by other bands—although when two bands happened to be close together, there was no friendly interchange. Chimpanzees, as far as I can judge from recent studies (all of this field work has been beautifully summarized in a book edited by Irven DeVore, *Primate Behavior*) are best described as miscellaneous, with shifting patterns of social behavior that hardly involve either aggression or territoriality. As for those protohominids, one would have to have a time machine to go back and find out about their behavior. But however our remote ancestors really acted, I think Ardrey has written a thought-provoking book.

There have been many published reactions to these books. One I particularly liked was written by the British anthropologist Geoffrey Gorer, in *The New York Times Magazine* for November 27, 1966. Gorer points out that there are a few completely non-aggressive human societies. "What seem to me the most significant common traits in these peaceful societies," he writes, "are that they all manifest enormous gusto for concrete physical pleasures—eating, drinking, sex, laughter—and that they all make very little distinction between the ideal characters of men and women, particularly that they have no ideal of brave, aggressive masculinity."

I wish I had thought of that. I have been belatedly reading Claude Brown's *Manchild in the Promised Land*, about growing up in Harlem, where both masculinity and aggression are rampant. It reads like a neat demonstration of the Gorer thesis.

When I started out to write about aggression this month I intended to recount some of the events I have observed in the "experimental rain forest" that I described last month. But I found myself getting onto the general topic of hummingbirds, which are about as aggressive as an animal can be. The inhabitants of my indoor jungle obviously deserve a column to themselves—maybe next month.

Marston Bates is a well-known author who also teaches biology at the University of Michigan. His column will appear regularly in Natural History.

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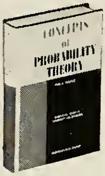

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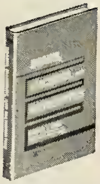

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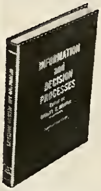

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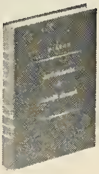

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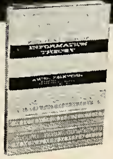

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NOISY CHORUS OF THE SEA

Some fishes gnash their teeth, others sound like foghorns—the porpoise whistles and squeals—crustaceans add to the clamor by clicking and rasping. Through use of the spectrograph, we now know more about the sounds of alarm, feeding, mating, and reconnaissance

By WILLIAM N. TAVOLGA

In recent years most people have come to realize that the sea is not the "silent world" of Jacques Cousteau's well-known book on undersea adventure. In reality, the oceans are at least as noisy as, and often noisier than, our average terrestrial environment. There are several reasons for this. One of them, as we shall see later, is the varied and large amount of sound contributed by water currents and marine animals. Another lies in the very nature of the medium. Water is a far better conductor of sound than air because it is about a thousand times denser; also it is virtually incompressible under normal circumstances. Consequently, more energy is required to start the movement of sound through water, but once started, this acoustic energy will be transmitted farther and much faster. The velocity of sound in air is about 330 meters per second (1,080 feet per second); in water it is almost 1,500 meters per second (4,920 feet), and these figures are significantly affected by changes in temperature and pressure. In the oceans, since salt water is denser than fresh, the velocity may go as high as 5,050 feet per second—almost five times greater than in air.

The transmission of sound through sea water is further enhanced because much of the sound is conserved by reflection. It is reflected from the surface of the water (up to 99.9 per cent of the energy is reflected back); from the sea floor; and from the interfaces formed by layers of water that are at different temperatures.

One other fact must be considered, however. We are not aquatic beings. Even with Scuba gear we cannot match our air-adapted ears to underwater sounds, and it is difficult for us to conceive what the marine environment sounds like. We must, therefore, use artificial hearing aids, as it were, to translate for us.

Measuring the Sound

In addition to the frequency of a sound, commonly called its pitch, we must know something of its intensity or volume. This we express in units called decibels (abbreviated to dB) Decibels are actually logarithmic values, and it just happens that our sensory processes, including hearing

ollow some approximation of a log-
rithmic law. Our perception is such
hat when one sound seems twice as
oud as another, the actual difference
nay be very large or very small, de-
ending on the absolute intensity of
ne two sounds. One decibel is close
o the minimum difference that we
an detect in the intensity of two
ounds, but a one-decibel difference
n a very soft tone is an extremely
nall difference in pressure, while
a loud tone it may be ten or a
undred times greater. A decibel,
erefore, is a relative measure and is
ways given in reference to some
eselected zero point.

In human hearing, the reference
oint is the lowest sound pressure
a frequency of 1,000 cycles per
cond that the average human ear
can detect. By convention this pressure is set at 0 decibels. But for underwater acoustics, where the sensitivity of the human ear has little significance, the reference is now generally the sound pressure of one microbar, also set at 0 decibels. The microbar is a small unit, equal to a force of one dyne (about two millionths of a pound) acting on an area of one square centimeter.

If we measure the sound pressure in the sea under ideal weather conditions, with no boats or noisy animals about, the ambient noise (expressed in decibels with reference to one microbar) is about 15 decibels *below* the reference point, or -15 dB μb. This background noise would be produced by the friction of water currents, just as a gentle breeze in air might produce a slight rustling sound. Such an ambient level in the ocean would roughly compare to that of a quiet winter night in the country.

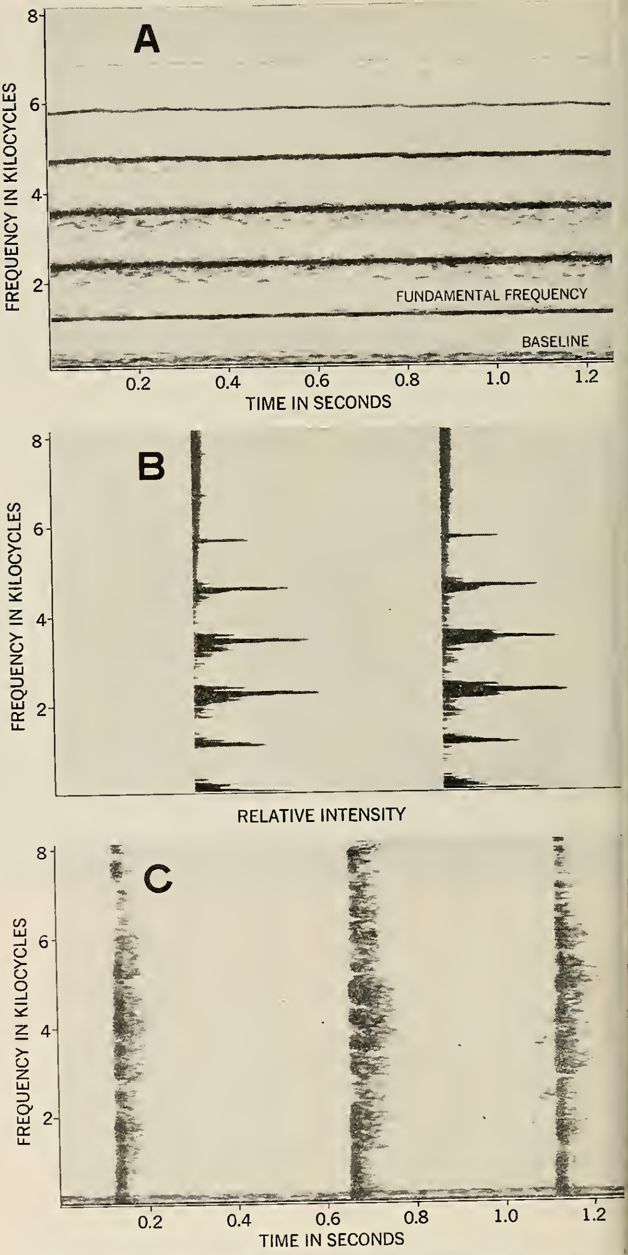
The more usual situation, however, includes noise produced by wave motion, by vertical and horizontal currents, by water friction against the sea floor, by the noise of boats and ships, and, superimposed on all that, the noises of marine animals. The average level of ambient sea noise becomes about 10 or 15 decibels *above* the one-microbar reference level. This is comparable to a busy office with typewriters clattering, papers rustling, people walking and talking, telephones ringing, and the din of outdoor traffic. The contribution of marine animals is quite significant. It can add as much as 20 or even 40 dB to the ambient noise level and is often in frequency ranges that interfere with sonar gear, acoustic mines, and underwater listening equipment.

We can always use words to describe a sound; in fact, words are the only tool we have when no tape recorder is handy. Unfamiliar and unusual sounds tend to be characterized by words that give the reader the general idea. For marine animal sounds, the literature is full of such descriptions as: grunt, foghorn, squeak, blat, buzz, etc. These are all highly subjective terms that may bring different auditory images to different readers. It is therefore necessary to use more objective criteria: usually the sound's duration, pitch, and quality (timbre).

Quality is the most difficult to describe because it depends on the combination of harmonics that are present—for example, the difference between a clarinet and a violin playing the same note. Harmonics are defined as frequencies that are multiples, in cycles per second, of the fundamental pitch. Thus a tone with a fundamental frequency, also called "first harmonic," of 500 cps might have simultaneous harmonics at 1,000, 1,500, 2,000 cps, and so on. Relative intensities of the harmonics account for the different tonal colors we perceive as timbre. A sound that contains *all* the audible frequencies at equal intensities is a "*white noise*"; if it contains many frequencies that are not harmonically related, it is generally called a "broad-band noise." Noises of the latter type frequently occur in nature, and these, too, vary in quality.

Sounds can, of course, be recorded on tape and preserved this way for comparison by the human ear, which is probably the most sensitive audio analyzer available. It is desirable, however, to obtain a picture of the sound, then describe it in visual terms. The cathode-ray oscilloscope, together with various meters and filters, can serve to analyze and measure complex sounds, but there is now an instrument that can perform many measurements and simultaneously provide a picture of the sound.

This is the sound spectrograph, which does for sound what a spectroscope does for complex light. It



With pictures like these, the sound spectrograph shows what we hear. (A Above the baseline is the fundamental frequency in high C from an organ then come five harmonics, the remaining parallel stripes. (B) Sampling of sam organ frequencies, but spectrogram here shows their relative intensities, whic account for tonal color. (C) Repeatedly snapping one's fingers gives vertic bars crowded with unrelated frequencies. Many marine animals produc similar broad-band noise in other ways, such as by rasping or clicking.

can sample a sound and produce a graph showing all the component frequencies, as well as their duration. Even relative intensities of various harmonics can be estimated from the intensity of the blackening on the paper. The instrument can provide such measurements more accurately by taking a sample of a few milliseconds of the sound and producing a picture in which relative intensity is plotted against frequency. A third type of record that can be derived shows changes in intensity with time.

It takes some experience to read a complex spectrogram, but a few characteristics are easy to see. In a spectrogram of a sustained tone, as of a high C on an organ, the fundamental shows as a horizontal stripe at almost 1,050 cps, and the harmonics are a series of parallel stripes at equal intervals. The foghorn sound of a toadfish is similarly harmonic (*see spectrogram, page* 24), although its dominant component is a tone at about 250 cps (close to B just below middle C), with several harmonics. By contrast, a short pulse, such as produced by snapping the fingers, shows as a vertical bar containing many closely spaced, unrelated frequencies. Such broad-band sounds are similarly produced by the clicking claws of crustaceans such as crabs and pistol shrimp.

By means of additional electronic manipulations, the spectrograph can provide a variety of other displays, all serving to describe, measure, and characterize a sound, and enabling a visual comparison of different sounds. (When used to study human speech, this type of machine can provide "voice-prints" showing individual characteristics of human voices.)

The marine animals commonly recognized as sound-producers can be broadly divided into three groups. (1) The invertebrates include crusaceans (crab, shrimp, lobsters) as principal sonic forms; also some mollusks and a few other forms. (2) The vertebrate class of fishes inludes many sonic species among the 0,000-odd known forms; perhaps a majority of these are at least potenal sound-producers. (3) Virtually l known species of marine mammals are sound-producers, princially the cetaceans (whales, dolhins, porpoises).

The Noisy Crustaceans

Most crustaceans can produce various clicking or rasping sounds with their claws, mandibles, and other parts of their shell-encrusted bodies. The sounds often accompany normal locomotion, but there are many species that produce sounds at other times by specialized structures. Among these is a large family of tropical and subtropical snapping shrimp, also called pistol shrimp—not to be confused with any of the commercially valuable shrimp, which are virtually silent.

The snapping shrimp are a small, secretive, and often colorful species present in tremendous numbers in coastal waters, coral reefs, and other rough-bottom areas. The enlarged chela of these shrimp is capable of snapping vigorously enough to propagate a strong, clicklike sound. Tens of thousands of the little animals can form a chorus that sounds like a crackling, sizzling blast of static on a radio; this background noise is common in coastal areas of warm seas throughout the world.

Many other invertebrates contribute to such static. Some crabs and lobsters possess specialized rasping areas on their bodies and appendages. The attachment threads of some mussels are thought to produce a soft, clicking noise when the threads are broken or pulled loose by waves. And the parrot-like beaks of squid and octopus produce a metallic rasping noise when they feed.

The basic sound of invertebrates is a click—a short pulse of noise. A single click from the snapping shrimp lasts about one millisecond, and each contains frequencies over a broad portion of the audible spectrum from 20 to 20,000 cps, and perhaps higher. These pulses are powerful: at a distance of a yard, their intensity may reach over +50 dB μb. Consequently, the din from large numbers of shrimps can mask the many other sounds of both natural and human origin.

We can only guess at the functions of the crustacean sounds. Some may be related to territorial defense; others may serve as cues in reproductive behavior; in many cases they may be merely incidental to feeding. There has been virtually no experimental work in this area of invertebrate behavior, and the field is wide open for research.

Sounds From Fishes

Marine fishes produce three general types of sounds: stridulations (rubbing or rasping), swim-bladder vibrations, and hydrodynamic disturbances.

The stridulations roughly compare to the sound of crickets rubbing their wings together. Such movement of one rough surface against another gives a rasping noise, a series of short broad-band pulses. Many species of fish produce them when they gnash their teeth or rub patches of denticles in the pharynx. Usually the sounds come during feeding; other times during fright or serious difficulty, as when the fish is captured. There is some evidence that such seemingly incidental sounds are actually a primitive form of communication. For instance, a fish hearing these "feeding sounds" can associate them with the presence of food and respond accordingly. Japanese researchers report that fish of the same species have even been attracted to the played-back recording of such sounds.

By and large, however, stridulatory sounds are similar in most species and do not seem to be highly specific. Spectrograms often show a predominant frequency in the range of 50 to '100 cps. This probably represents the rhythm with which the teeth strike each other while rasping.

The most efficient and highly evolved sonic mechanism in fishes is the swim bladder. Originally, this thin-walled, air-containing sac probably served to control the buoyancy of the fish. It now has several other functions. In many species it is equipped with a set of specialized muscles capable of vibrating at surprisingly high rates (up to at least 300 contractions per second in some species). For this drumming sound the entire swim bladder with its enclosed air, serves as an underwater loudspeaker of considerable efficiency. Prominent producers of such sound are members of the drumfish family (family Sciaenidae), including croakers, sea trout, and sea drum. Several species of sea basses (including groupers), marine catfish, toad-

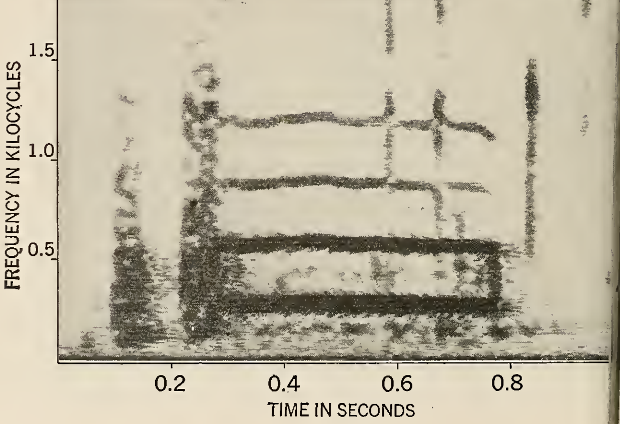
fish, squirrelfish, and many others also are drummers.

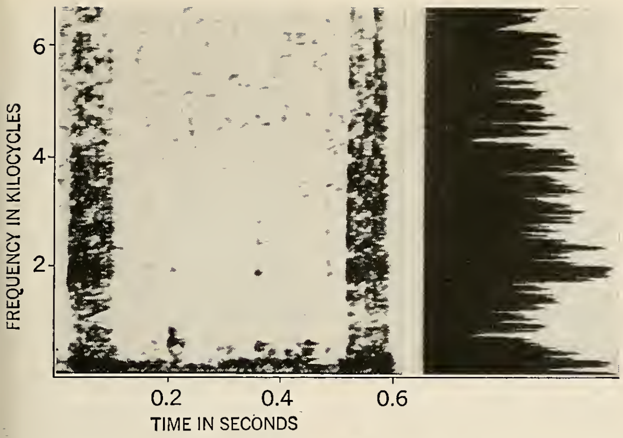
These sounds are basically harmonic, with a fundamental frequency varying from 100 to 500 cps, depending on the species. Some are of short duration, about 0.1 second, and are repeated rapidly enough to give a rattling or hammering effect. Often a particular species can be recognized by the pattern of these pulses. The toadfish, on the other hand, produces a long, sustained call, lasting about a half second and resembling a distant foghorn (*see* "Foghorn Sounds Beneath the Sea," NATURAL HISTORY, March, 1960).

The biological significance of many of these sounds remains obscure. In a few cases, as with toadfish and drumfish, the drumming is clearly related to spawning behavior and comes only from males. In others, as with groupers and squirrelfish, the explanation is territorial behavior—a resident animal sounds off when approached by an intruder. But there are also puzzling areas. Alarm and fright often evoke sounds; just as often, they halt the sonic activity. This brings up a major problem in studying the behavioral significance of fish sounds. In captivity, the creature's sound production often ceases, and it is difficult to set up controlled experiments under field conditions. Observations, visual and sonic alike, are in themselves insufficient; experimental studies are needed.

Now let us briefly consider the third type of noise produced by a fish. While swimming, it produces a strong, local displacement of the water. Such a hydrodynamic disturbance is not strictly a sound according to some definitions. But it represents energy that can be detected by a hydrophone, and it possesses many physical properties of a sound. Because its frequency is very low, it can even sound like an earthquake or explosion. Hydrodynamic disturbances are especially evident when the fish abruptly changes velocity or direction. Fishes are definitely sensitive to such displacements in the water, and probably detect them by means of their lateral line system, which i a series of bundles of hair cells lo cated within pits or canals on th

The male toadfish emits a foghorn sound, which is part of spawning behavior For this call, the air-filled swim bladder serves as an underwater loudspeaker The result, in spectrogram, is an orderly sound—fundamental frequency plu harmonics. Narrow vertical lines are background noises from snapping shrimp





The spiny lobster contributes to the underwater din with characteristic rasping produced by a filelike area at base of its antenna. Spectrogram shows: (left) two raspings, with time plotted against frequency in cycles per second; (right) intensities of the discordant frequencies that produce the unmusical sound.

head and along the sides of the body. The lateral line system is sensitive to minute displacements, so it is a detector of ordinary low-frequency sounds transmitted through water.

Most recent evidence indicates that marine fishes are quite sensitive to sound reaching to 500 or 600 cps ("Psychophysics and Hearing in Fish," Natural History, March, 1964). Above this frequency, their sensitivity drops rapidly, and most species are virtually deaf above about 1,500 to 2,000 cps. By contrast, man hears best at about 1,000 to 2,000 cps, and his range extends at least up to 10,000 cps.

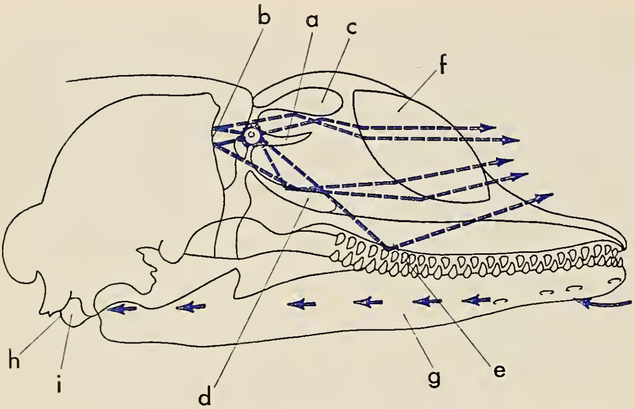
The majority of fishes can also detect sounds through the inner ear. In this the swim bladder again plays an important role. The body of a fish has a density close to that of the water it swims in, so a fish is virtually transparent to water-borne sound. Because the swim bladder is filled with air, it functions like a microphone by responding to these vibrations and transmitting them to the inner ear.

The Marine Mammals

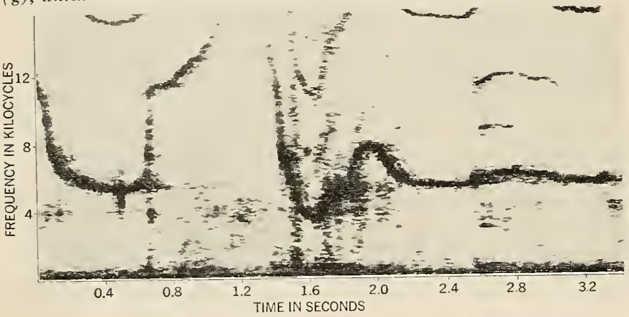
In contrast to fishes, cetaceans are warm-blooded, air-breathing mammals, and include a variety of forms, commonly called whales, dolphins, and porpoises. These produce sounds that fall into two general categories: (1) short. broad-band sound pulses, or clicks, and (2) sustained whistles, squeals, and other cries.

Cetaceans are divided into two groups. The larger forms are the baleen whales, which feed upon planktonic material. They belong to the suborder Mysticeti. The smaller species, all belonging to the suborder Odontoceti—the toothed whales—have well-developed teeth and are hunters of food, primarily fish and squid. In this predatory group are a few relatively larger species (sperm whale and killer whale) and some smaller ones, such as the pilot whales. Relatively small, too, are the porpoises and dolphins. (Although there are technical distinctions between the two, we shall follow the common usage of calling them either porpoises or dolphins.)

As far as is known, all the species



Porpoise head is adapted for beaming sounds. After vibrations from tubular sac (a) bounce off concave forehead bone (b), they can move forward as follows: by reflection off sac (c); or, farther down, off sac (d); or off upper jaw (e). Most of the sound is then focused by an acoustic lens, the oil-saturated "melon" (f) at top of head. For reception, the porpoise can use its lower jaw (g), which transmits to dense bone (h) surrounding inner ear (i).



Two porpoise whistles in succession: Each one starts as a high sound, quickly dips in pitch, and then rises again. The separate, higher lines are harmonics.

of toothed whales produce the short, pulselike clicks. Sometimes, each of these broad-band sounds lasts less than 10 milliseconds and contains component frequencies ranging well above human hearing—a range of 100 to 100,000 cps is not uncommon. The clicks come from a specialized vibrating organ found within the complex of air chambers leading to the blowhole. It has been shown that these clicks are primarily intended to locate objects by means of the returning echoes. This highly efficient and accurate sonar system rivals that of bats. Echoes from the clicks give the marine animal much information about its environment, especially the location and type of food that it is hunting.

For long-distance reconnaissance, the clicks are produced at a slow rate. As the animal approaches a target and the clicks increase to well over 200 or 300 per second, their succession begins to sound like a buzz (often called the "rusty hinge" sound). Most research on this sonar ability has been done with a single species, the familiar bottle-nosed porpoise or dolphin (*Tursiops truncatus*). Because it is a particularly docile animal, readily trainable to perform circus-type tricks, it can be studied and tested under various captive conditions.

The bottle-nose and other species can increase the click rate to a frequency so high as to sound almost musical—especially when trained to do this with their heads out of water. Some observers have mistakenly thought these sounds to be a means of communication, indeed a language. At least one experimenter has even spent years trying to teach a porpoise to speak English—with a notable lack of success.

Along with clicks, most of the toothed whales emit high-pitched whistles and squeals, whose pitch can vary from 1,000 to almost 20,000 cps. The mechanism here has not been positively identified, but is believed to reside in the larynx. Such animals can emit clicks and whistles simultaneously. The contours of the whistles are variable, and often characteristic for different species. Some whistles have now been associated with different emotional states, such as alarm, fear, mating. There is good evidence that the sounds are communication between animals of the same species, probably on the level of complexity of dogs barking, perhaps even the gibbering and other vocalizing of monkeys and apes.

So far, research—limited to a few species of smaller-toothed cetaceans—shows the hearing ability of these mammals to be remarkable. The bottle-nosed porpoise, for example, is extremely sensitive to frequencies up to 50,000 cps, and can even detect 120,000 cps. This range of course, is far above a human' audible limits. With the echoes, th animal can locate food and also avoi collision with underwater obstacles

The hearing and sound-producin mechanisms are both highly specialized. A porpoise literally beams it echolocating clicks. The deeply concave forehead of its skull serves as bony parabolic reflector to direct th sounds forward. In addition, th large bulging "melon" on the fron of its head is composed of an oi saturated tissue acting like an acou tic lens. This tends to beam the ou going sound.

Likewise, it is now known th the sound-receiving system is high directional. The lower jawbon contain long, narrow, oil-filled cha nels; apparently, the sound is pick up by the lower jaw, transmitt through these channels, and then r layed, via the jaw hinges, to the bo encased mechanism of the inner e

Even the brain structure of a p poise shows adaptations for acous sensitivity. The brains of cetaceans are relatively large, and this enlargement involves the temporal lobes to a great extent. These portions of the brain are primarily concerned with hearing and, probably in this case, echolocation.

The large baleen whales, unlike the toothed cetaceans, are not definitely known to produce any echolocating clicks, but they do give a variety of sustained cries—mostly at a fundamental frequency of below 400 cps. The sounds of a school of humpback whales, for example, have been familiar to generations of whalers; sometimes they resemble moans, groans, or the mooing of cows. The function of these sounds is unknown, but possibly, like porpoise squeals, they are a means of communication.

One species of whale, the finback, which reaches a size of 70 to 80 feet and a weight of 90 to 100 tons, caused considerable perturbation some ten years ago among personnel manning various sonar listening stations along our Atlantic coast. With the improvement of recording equipment, it had become possible to detect extremely low frequency sounds, such as might be produced by large surface ships or submarines. The new equipment promptly began detecting strong sound pulses at a frequency of about 20 cps. Despite accurate tracking, however, no visual contact could be made either from investigating ships or airplanes. The sounds were extremely powerful and could be detected over distances of several miles. A cloak of secrecy was clamped down over these data by the military on the off-chance that the 20-cycle pulses came from unknown man-made vessels.

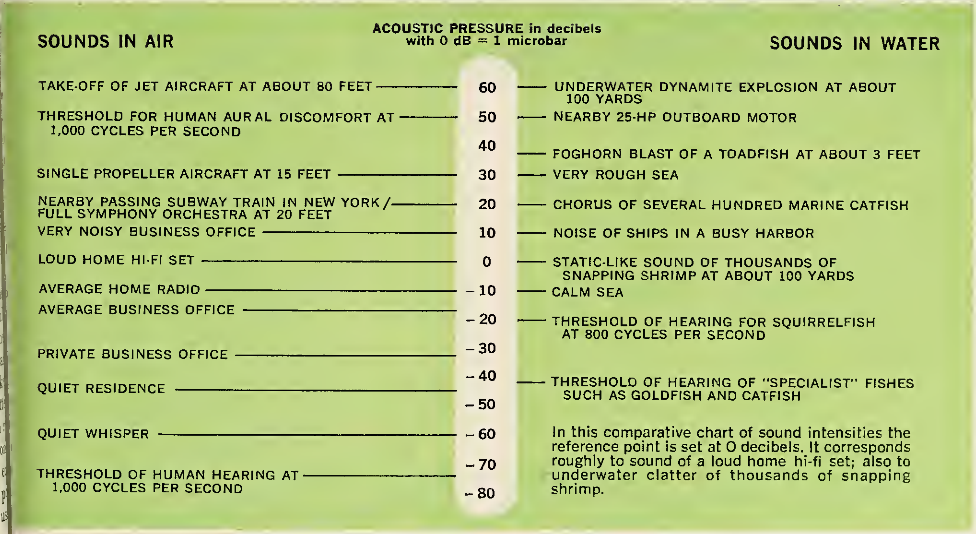
Eventually the culprit was identified as the finback whale (*Balaenoptera physalus*), whose shy habits made it difficult to sight while it was emitting the sounds. One investigator proposed that the sound was produced by the beating of the animal's huge heart. It is conceivable that the contraction of a half-ton of muscle could produce such a pulse, but newer evidence supports the idea that the whale produces them voluntarily, possibly as some form of communication.

Within the past few years, another group of aquatic mammals, although unrelated to the cetaceans, has also been found to produce underwater sounds. These are the seals and sea lions of the order Pinnipedia, closer allied to terrestrial carnivores than to the whales. Barklike and other pulsing sounds have been detected from several species, including the California sea lion frequently found in circus and aquarium shows. Although confirming evidence is still lacking, there are strong indications that these animals use such sounds for echolocation.

It is not really surprising that marine animals in general show so many adaptations that utilize the acoustic channel for various behavior patterns. The surprising aspect is that only recently have biologists come to appreciate this fact.

With underwater vision often masked by turbidity, with the chemical senses hampered by disturbing currents and slow diffusion rates, sound is therefore the most efficient long-range mechanism for supplying marine animals with necessary information about each other and the rest of their environment.

Meanwhile, technological advances over the past twenty years have given scientists an acoustic window into the ocean, and marine biology now can enlarge our knowledge of the behavior and distribution of marine life. This knowledge is essential and basic to all oceanographic studies, which are growing in importance as it becomes evident that future generations of man will depend increasingly on the seas for their food resources.



In this comparative chart of sound intensities the reference point is set at 0 decibels. It corresponds roughly to sound of a loud home hi-fi set; also to underwater clatter of thousands of snapping shrimp.

Entrance to Juxtlahuaca cave, which has been measured and marked for approximately a mile. The lanterns were used for photographing the paintings.

Oldest Paintings of the New World

by Carlo T. E. Gay

For years I had heard rumors about cave paintings in a remote valley of the Sierra Madre del Sur, in the Mexican state of Guerrero. Information about the cave's exact location was vague, and so was the description of the paintings. They were sometimes described as "witchcraft works," sometimes as "hunting scenes."

As time passed and more precise directions became available, it seemed worthwhile to investigate the Juxtlahuaca cave near the mountain village of Colotlipa. My first survey was made on July 26, 1966, with two companions—Gillett Griffin, an artist from Princeton, New Jersey, and Enrique, the son of the cave's caretaker, Andrés Ortega. The second survey was made on August 25. The material recorded during these two inspections included three paintings and three line drawings, along with various human skeletal remains and fragments of pottery.

On the basis of style and iconography, the paintings and drawings can be identified as belonging to the Olmec tradition, which flourished i Mexico during pre-Christian times Elsewhere in Mexico the distinctiv art style of that tradition is mainl exemplified by monumental sculptures, ceremonial vessels, and excellent figurines. Consequently, th Juxtlahuaca works came as a revelation. Deep inside the cave was evidence of a previously unknown aspec of Olmec art tradition—the earlies examples of large-scale painting ever recorded in the New World.

Colotlipa can be reached by ca from Chilpancingo, the capital c Guerrero. A few miles south of thi town, on the highway to Acapulco, dirt road branches eastward at th village of Petaquillas. The road fo lows the winding course of a preci itous canyon, which leads to an a ple valley flanked on both sides b high, brush-covered mountains. He the road continues its easter course, cutting through well-cult vated fields and occasional cluste of trees. Vegetation is especial luxuriant around Mochitlan a Quechultenango, the largest comm nities in the valley. Past Quechulte ango the narrowing road comes to easily forded river. From then on the trip proceeds smoothly to Colotlipa, 22 miles from Chilpancingo.

Colotlipa, which means "the scorpion above," is a neat, well-built village on the edge of a small alluvial plain where a group of valleys converge at approximately 2,600 feet above sea level. In this vicinity the sierra largely consists of limestone formations. Among several caverns existing in the area, only Juxtlahuaca has been explored and, according to local report, is regularly visited by the natives—in mid-September and Easter's Holy Week.

The cave is 3½ miles north of Colotlipa. The name Juxtlahuaca means "beautiful blue-green valley" and is derived from the name of a nearby hamlet. The site can be reached by two alternate footpaths along the Rio Blanco. Both require wading the small river at several points, but this is not difficult except after the late afternoon showers that occur during the rainy season.

The walk is mainly through fields and pastures. After an hour the entrance to the cave can be seen about 200 feet up the slope of a small mountain that rises from the east ide of the river.

Except for a couple of kerosene amps, a flashlight for emergencies, nd some drinking water, no spe-ial equipment is necessary for

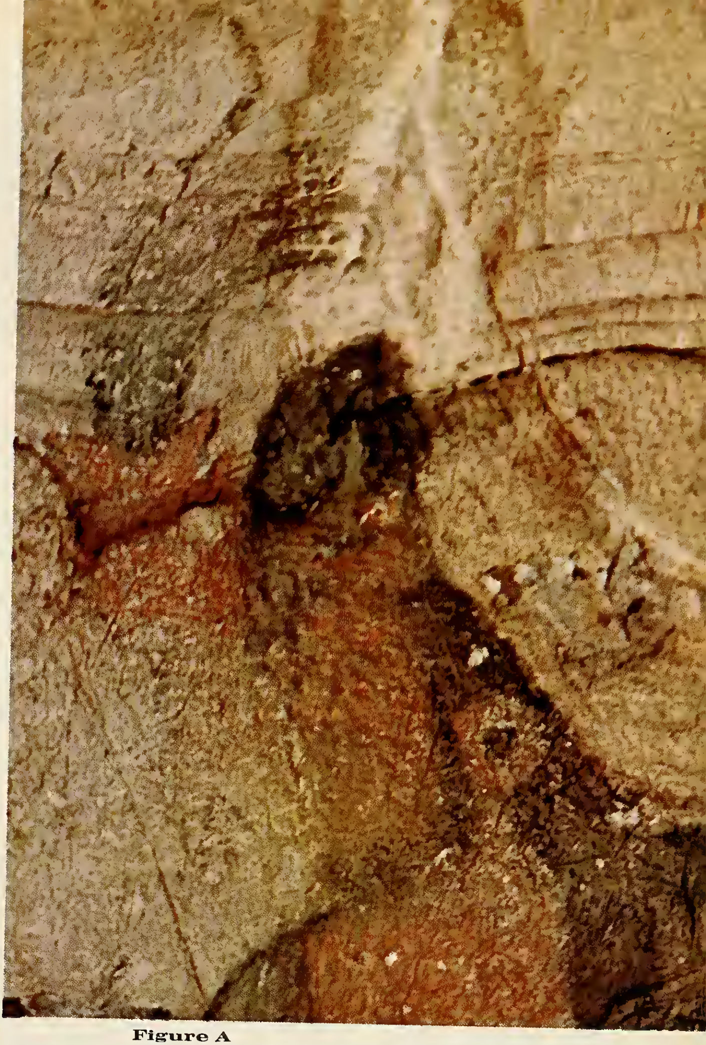


Figure A

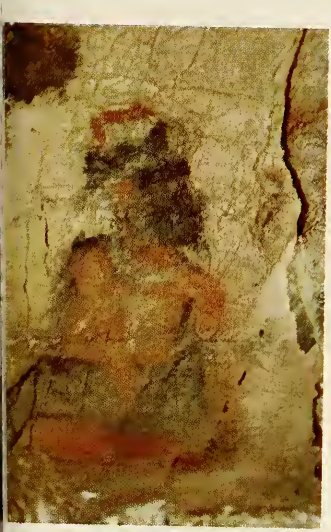
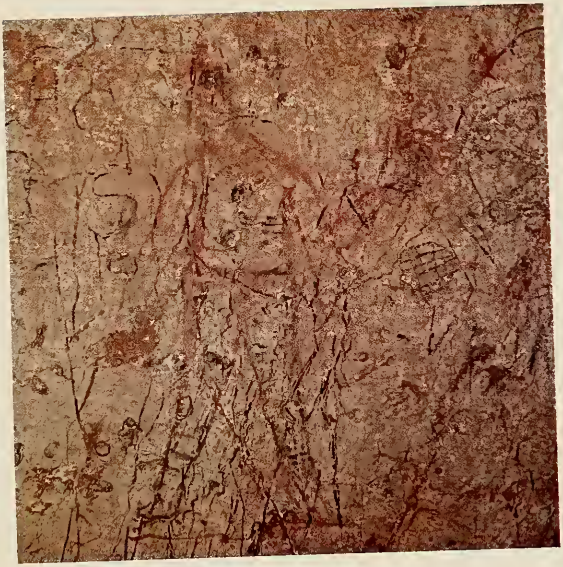


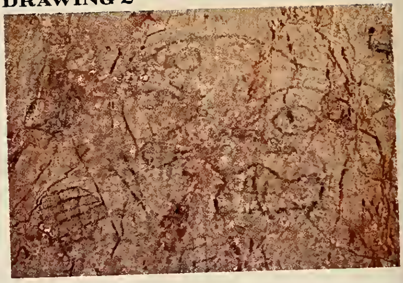
Figure B

PAINTING 1 *The first painting seen in the cave, about 3,400 feet from its entrance, shows two figures possibly engaged in an Olmec ritual of ancient Mexico. For their relative size and positioning, see this issue's cover. They have been separated on this page, and enlarged. Above is the head-and-shoulders portion of dominant Figure A, which is 5 feet 5 inches tall on the cave wall. He is looking down upon and may be exorcising submissive Figure B; the latter is in a seated posture typical of Olmec art. The colors used in the Juxtlahuaca representations were apparently red and yellow ocher, as well as a carbonaceous black (charcoal, bone, or soot). All of the cave works are still in good condition, but calcite has obscured some painted areas and some of the black has faded.*

DRAWING 3

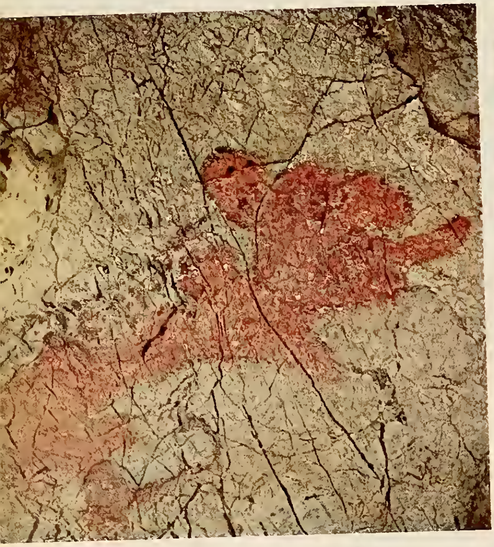


DRAWING 2

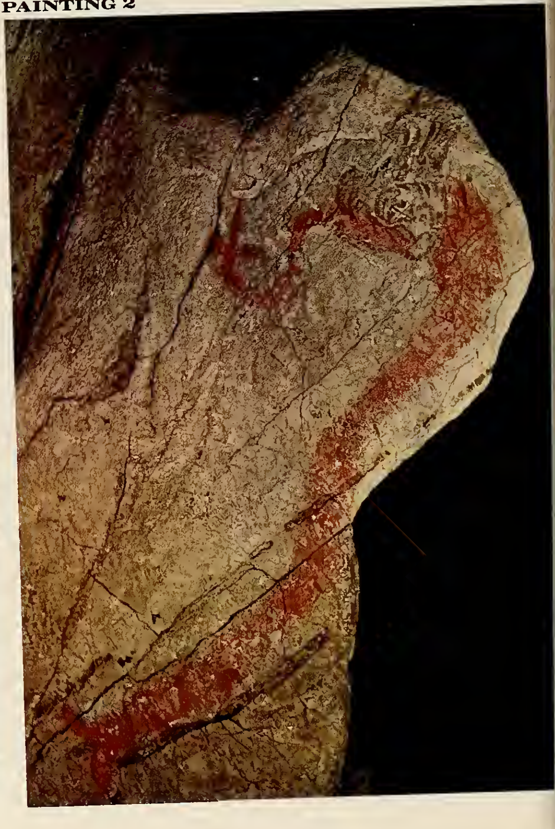


The composite reconstruction, above right, is supplied to clarify details of these two works and to show their relative positions on the wall of the cave. Drawing 2: Possibly a preliminary sketch, it portrays a serpent head partly obscured by a superimposed feline head. Drawing 3: Front view of a man, who is naked except for a loincloth, reveals the ancient artist's appreciation of the anatomical details portrayed.

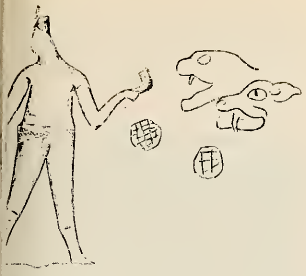
PAINTING 3



PAINTING 2



Painting 2, right, was executed in a way that suits the natural contour of a slab jutting from the cave wall. The cruciform-shaped tail of the seven-foot "plumed serpent" may be a stylized representation of a snake's rattle and button. Above: Facing Painting 2, this picture's strange, small animal apparently is leaping toward the serpent. But the latter, because it rises higher on the slab, dominates the scene.



exploring the cave, which takes about five hours. About a mile of the cave has been accurately measured by an architect from Chilpancingo, with the help of Andrés Ortega, and markers at regular intervals give distances in meters. It is advisable, however, to be accompanied by Ortega or his son. Both are excellent guides and entertaining companions.

At the start the course is more or less horizontal, and the visitor is greeted by swarms of bats and giant cockroaches. (It is best not to linger in this section because a potentially dangerous disease, histoplasmosis, can be contracted in bat-infested caverns.) About 600 feet from the entrance a small opening leads into a series of progressively lower rooms, separated by tortuous passageways through which it is sometimes necessary to crawl. Each room contains stalactites and stalagmites, as well as gracefully curving formations that resemble draperies. Stately pillars and precarious columns rise from the floor to join overhanging formations; massive flowstones cover the walls with frozen cascades colored the most delicate pinks and creams.

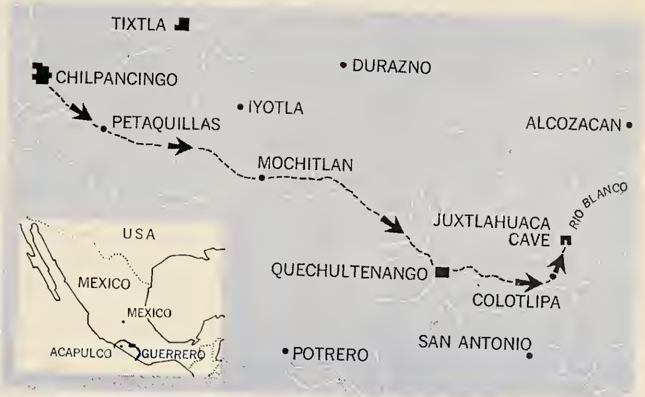
Two thousand feet from the entrance is a small room, which the map of the cave (*page 33*) designates Chamber of the Drum. Here, a series of hollow stalactites of various lengths and shapes hangs in front of a natural cavity; when they are tapped the resulting resonance resembles that of a drum. Three red spots are painted on the wall of the niche, indicating perhaps that it had some use in ancient times. Farther on, the cavern becomes increasingly larger until it opens into a huge hall (*see map:* Hall of the Dead) where a massive cave-in occurred at one time. Nearby, we counted the skeletal remains of three children and eight adults. In each instance, part of the skeleton is embedded in stalagmitic crust. It is evident that many bones have been removed. Of three skulls, for instance, only those fragments strongly adhering to the floor are still *in situ.* A fourth skull is intact, except for a recent break on one side. Originally placed in a natural cavity, it is now completely covered with a thick, creamy colored layer of crystallized calcite. Recurrent flooding of this section of the cave during the rainy season accounts for the deposit. (On our first visit the cavity was dry; a month later the skull was a foot under water.) It is possible that the large hall and adjacent rooms once served as a repository for the dead.

A number of potsherds can also be found in and around the same area, usually well separated from the bones. Most are fragments of undecorated vessels. The lower portions of two flat-bottomed, cylindrical pots are embedded in stalagmitic crust. Nothing is left of a third vessel—which had a rounded bottom—except for a small fragment and a clear imprint in the solid floor.

Proceeding farther, the cave resumes its horizontal course. Beyond the 3,100-foot marker is evience of an ancient canal dug into a layer of red clay that covers the floor. Zigzagging about 250 feet through rooms and passageways, it leads to the first hall of the paintings. It was probably dug to free this hall from periodic flooding, and is labeled Drain Canal on the map. Part of the length is still flanked by earth removed by the diggers; in other places, the earthen banks have been obliterated. The canal, now filled with stalagmitic crust in the upper course, is no longer serviceable. It is from two to three feet wide, but its variable depth cannot be measured without freeing the system of deposits and debris.

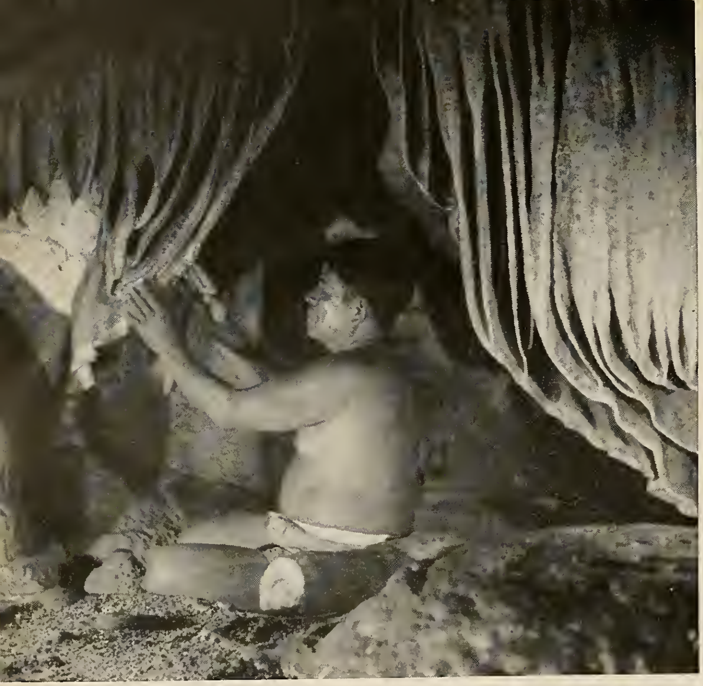
The first hall of the paintings (*see map:* Hall of the Ritual) begins about 3,400 feet from the entrance. This room, measuring about 100 by 40 feet, has a low ceiling, an even floor, natural cavities to the left, and a compact wall to the right. This wall is partially free of calcite deposits and relatively smooth.

Painting 1 is my designation for an extraordinary scene depicted on the surface of this wall, about thirty feet inside the hall. It portrays two human figures, apparently engaged in a ritual. To the right, Figure A stands firmly on parted legs and looks down upon Figure B, who is sitting. Figure A, measuring 5 feet 5 inches in height, is garbed in a polychrome shift, a black pelt thrown over the left shoulder, spotted leggings and gauntlets, and a plumed headdress. The shift is patterned with three red, horizontal bands separated by yellow ones bordered with black. The pelt is completely black



To reach Juxtlahuaca cave, the author traveled by way of Chilpancingo, the capital of the state of Guerrero.

The black square on the inset represents the area in Guerrero (ringed section) shown in detail on large map.



Left: Chamber of the Drum. When guide Andrés Ortega taps these stalactites, the resulting sound is amplified by the natural wall cavity behind them.

Above: Calcite has crystallized around this skull. It is one of the skeletal remains found in the Hall of the Dead.

except for its spotted tail, which appears between the legs of the figure. The tail seems to be that of a jaguar. Its pattern of ovals and black spots is repeated on the leg and arm coverings of the figure. Why isn't the rest of the pelt spotted? Perhaps it was painted in after the figure was completed and had to be a solid color to mask the garment's polychrome pattern. This assumption is possibly substantiated by the faint traces of red showing through the pelt.

The headdress is elongated, and attached to its front is a red, cleft device. A tuft of feathers held by this device falls backward; one of the feathers is upturned. Conceptually, this headdress is similar to those worn by three of the figures on Relief II at Chalcacingo, Morelos (*see* NATURAL HISTORY, *August-September, 1966*).

Figure A has shoulder-length black hair and a line of beard around the jaw. A circular ear ornament is indicated. Other details, including the facial features, are indistinct because an efflorescence of calcite, seeping from above, runs as far down as the chest. The calcite has absorbed some of the colors, but the main elements of the representation remain discernible. If further seepage is not checked, however, it may eventually blur the entire figure.

Figure A holds a trident-shaped implement in the right hand and, in the left, a serpent, or serpent-like staff. Both objects are extended toward Figure B. A barely visible motif, shaped like an 8, is in front of the trident, possibly indicating a more complex original design. Both motifs correspond to recognizable Olmec signs occasionally found on clay vessels, roller stamps, stone figurines, and miscellaneous objects, principally from central Mexico. A trident sign can also be seen on the belly of the reptile portrayed on Relief V at Chalcacingo. According to my interpretation, this sign is sometimes part of compound forms of lunar symbolism. The same holds true for the serpent motif.

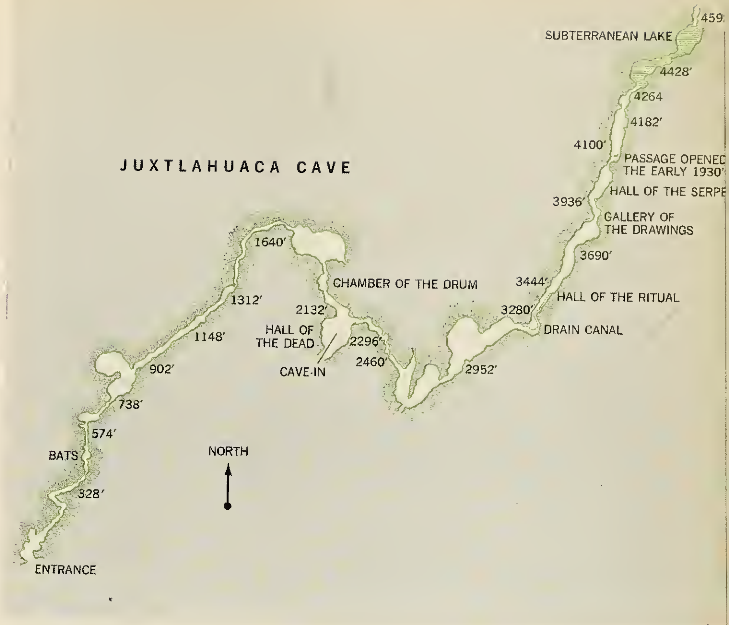
The genus of the serpent held by the figure is not identifiable because it lacks details, other than black spots along the belly line. On the other hand, the polychrome design of the shift can be compared with the banded pattern of the tropical king snake (*Lampropeltis polyzonus*). The two patterns are surprisingly similar, not only in color but also in the relative position and width of the bands. (It should be noted that the black lines of the garment are somewhat faded, and show even less in the photograph.)

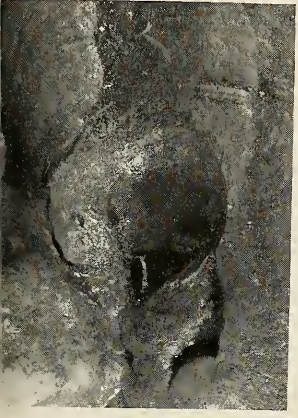
Figure B, measuring 1 foot 9 inches in height, is seated, with arms extended to the knees in a familiar Olmec posture. Because the lower area is blurred we have not been able to establish whether the figure is shown cross-legged or with its legs folded under.

The body, in three-quarter view, is painted red, and appears to be naked except for a wide, black sash around the waist and an ornamen at the neck. The face is in profil and is black, except for its eye cavit and the tip of the nose, suggestin the possibility that a mask is worn A few strokes of black paint unde the chin may indicate a beard. An oval element on the side of the hea may be an ear ornament.

The head, tilted slightly back, i covered with a black-and-re headdress. This curiously resemble a hat, with the brim turned up i front. A faint line of color showin behind the head gives the impressio

Beyond its entrance, Juxtlahuaca cave meanders 4,000 feet through passages and halls. Then come the partly submerged rooms of Subterranean Lake.





lthough the artifact is missing, its
ear imprint remains—it probably was
round-bottomed piece of pottery.

a horn-shaped element attached
the headdress. (This detail was
ticed only after close scrutiny of
e photograph, and will have to be
ecked on the painting itself.)

Considered as a whole, Painting 1
a candid and direct pictorial state-
ent, which can be identified as be-
nging to an early stage of develop-
ent of the Olmec tradition. The
tual significance of the composi-
n is open to speculation. Figure A
pears to be performing a ritual
orcism upon Figure B. The latter
ght represent a spirit of the earth,
unlike the Maya god Mam, the
d god of the earth's interior.

Drawing 1 is thirty feet across the
l, directly opposite the painting.
e drawing is executed at eye level
the white surface of a natural
ar. It is partly concealed under
vs of calcite; the visible part is
roximately eight inches high.
ugh is left of this black line draw-
to suggest the possibility that it
resents a building surmounted by
rnamental crest. The perspective
bviously distorted. The curved
s slanting downward, below the
ilding," may be intended to de-
be a mound or platform. Inas-
h as the main structure is delineated as a framework consisting of posts and lintels, the drawing may depict a temple structure of perishable material. There seems no reason for its presence other than to emphasize the ceremonial character of the Hall of the Ritual.

Beyond the hall comes a series of passageways; along their right-hand side are Drawings 2 and 3, at a point 3,900 feet from the entrance (*see map:* Gallery of the Drawings).

Drawing 2, which is 1 foot 4 inches high and 2 feet wide, portrays a feline head partially superimposed on a serpent head, both in profile. The black line drawing, more or less at eye level, is precise and descriptive. The serpent, more realistically portrayed than the feline, resembles an ophidian of the genus *Micrurus*, with short and permanently erect fangs—characteristic, for example, of the tropical coral snakes. Below the animals are two incomplete circles, each enclosing an irregular, poorly executed checkerboard pattern. The meaning of this design is obscure. There is a possibility that a third animal head was portrayed, above and to the right of Drawing 2. However, the outline is indistinct and does not show on the photograph.

Drawing 3, nearby and somewhat larger (3 feet 6 inches high) than Drawing 2, is directly to the left. It portrays a male figure in front view, but with his head turned toward his right. Except for a loincloth, the figure is naked. Unidentifiable objects are in both hands. The figure, drawn in red, has an easy flowing line and indicates an appreciation of anatomical details.

Drawings 2 and 3 might be preliminary sketches for incompleted works. They seem isolated rather than part of a compositional whole. Free from any stylized form of conventional representation, they are another telling example of naturalism in Olmec art. Unfortunately, the surrounding space is marred with the initials of visitors.

The passageways lead to the Hall of the Serpent, a spacious, high-vaulted room 4,000 feet from the entrance and apparently the farthest point reached in ancient times. (According to Andrés Ortega, communication between this hall and a subsequent series of rooms, partly filled with water, labeled Subterranean Lake on the map, was established by two of his brothers in the early 1930's.) Two large animals are depicted here, on the right-hand side.

Painting 2 is a seven-foot "plumed serpent" that covers most of the surface of a large slab projecting at right angles from the wall. Its form is adapted to the natural contour of the rock; consequently the serpent is portrayed vertically, its head thrust out in striking position. The body and the tongue are painted red, but details of the head are in black. (The black appears almost brown in the photograph because of inadequate lighting and the prevailing red of the painting.) Both tail and tongue have an unusual cruciform shape. At the tail this may represent a stylized rattle and button.

Details of the head are of particular interest. The mouth is almost but not entirely closed, which occurs naturally when a tongue is protruding. A small fang and a series of reserve fangs are indicated. On top of the head, there are six feather-like elements, above a small, round eye. There is a possibility that this design, as well as the so-called flame eyebrows, may have derived from certain snakes, such as the eyelash viper (*Bothrops schlegeli*), with a distinct development of two or three supraocular scales that form a spiny horn.

At the center of the head is a glyphic element consisting of an Olmec cross; an S-shaped sign with two dots on either side, comparable to the Maya "percentage" sign; and a jagged design on the upper edge. This element is accurately drawn, indicating familiarity with conventional Olmec symbols. Conceptually, it is similar to a glyphic element on Relief I at Chalcacingo. Also for comparison, there is a striking likeness between this Juxtlahuaca serpent and the rattlesnake portrayed on Monument 19 from La Venta, Tabasco. Furthermore, six red spots, resembling the three found in the Chamber of the Drum, are painted on the edge of the slab, to the right of the serpent. They may be the painted equivalent of the cup marks found on Olmec monuments.

Painting 3, on the main wall and facing the nearby serpent, is 3 feet high and 4 feet 3 inches wide. It depicts an unidentifiable animal, possibly disguised as a feline, because, although painted red, it wears a spotted pelt. The only identification marks on the animal itself are two black spots on an ear. The animal is portrayed as if leaping toward the serpent. But the serpent looms higher and powerfully commands the scene, leaving little doubt as to which is symbolically prevailing in this mythical encounter.

The colors used for the paintings and drawings in Juxtlahuaca cave were apparently red, yellow ocher, and a black, possibly derived from charcoal, bone, or soot. The powdered pigments, probably mixed with an adhesive agent, could have been applied with a brush or pad. Isolated red spots may have been made by blowing color through a tube onto a wet surface. All the works are in good condition, with the exception of those areas that are covered with calcite efflorescence, and some of the black areas where the color has faded.

The repetition of serpent motifs in the cave is particularly significant. Here, for the first time, is convincing evidence that the serpent played a more important role in Olmec iconography than is currently believed. As a consequence it seems possible that such problematic Olmec designs as the "jaguar-dragon" represent highly stylized serpent motifs rather than jaguars.

On the basis of style and iconography, there can be no doubt that the Juxtlahuaca paintings and drawings belong to the Olmec art tradition. If it comes as a revelation that this tradition also included painted works, it is not surprising that they were executed in a cave. Normally, people of early times did not live deep in caves. But they did use them for religious purposes, principally because caves provided a semiarchitectural environment; in addition, the penetration into a seemingly inaccessible domain intensified the impression of magical power connected with sacred rites. Apparently the Olmecs of the area sought an appropriate setting for their rituals, and in

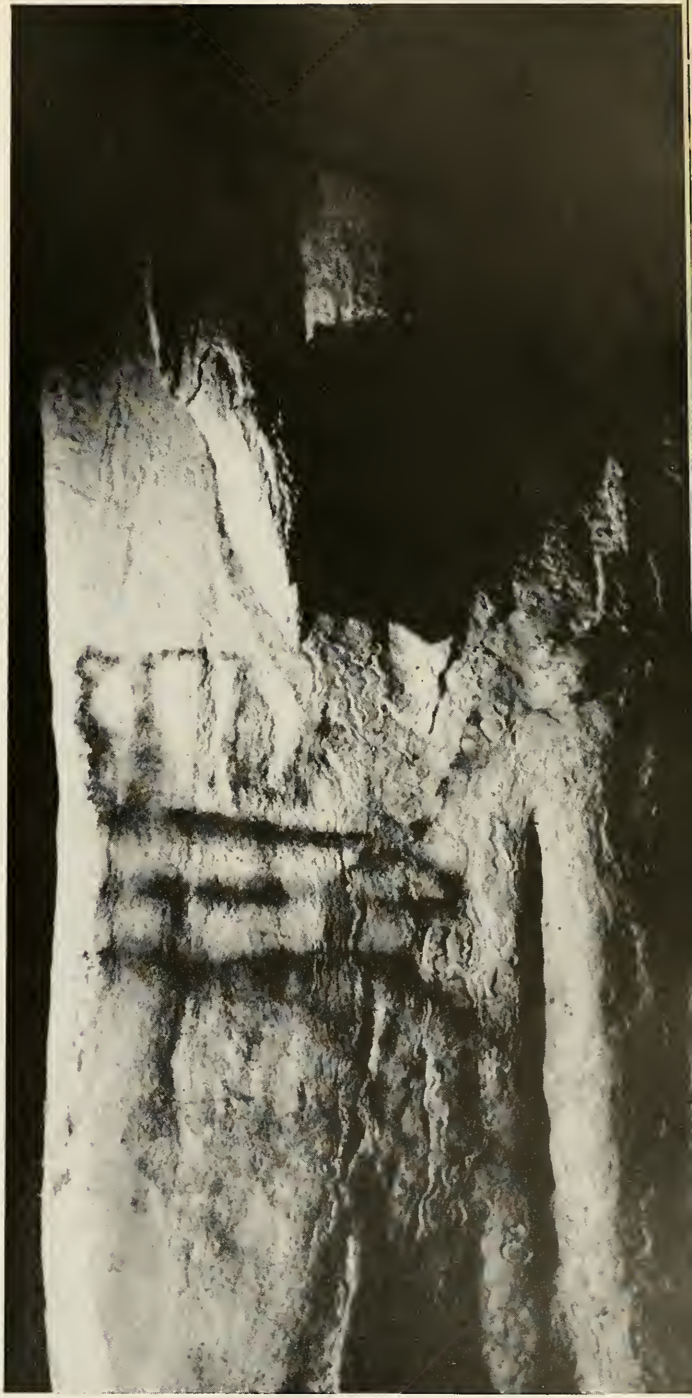
A water-color copy of Painting 2 is made by Gillett Griffin, a friend of the author. This artist recorded the cave's other art works in the same way.

the most remote recesses of the cave, they found walls appropriate for painting. There, in halls dimly lit by flickering torches, the cave was converted into a sanctum.

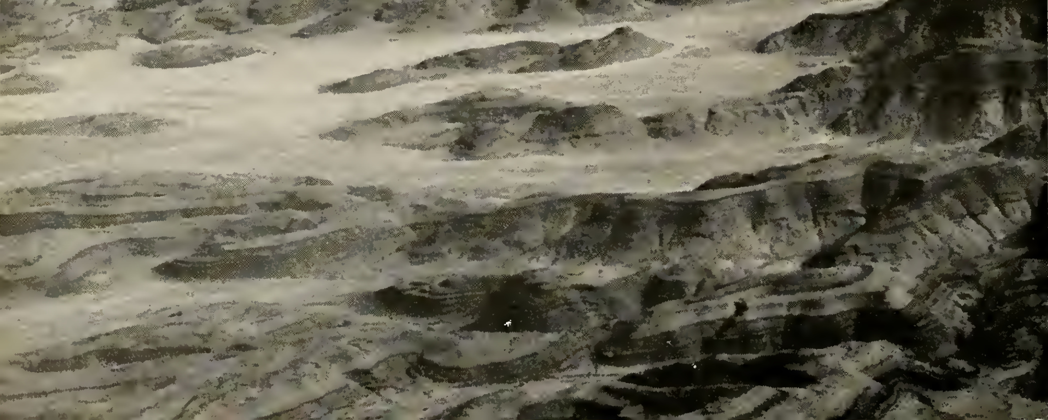
The geographic location of the works is not surprising either. It has been apparent for some time that Guerrero, particularly the region around the middle course of the Balsas River, was an important center of the Olmec tradition. As evidenced by numerous accidental finds of various kinds, there are at least three locations in the general area of the cave that have yielded Olmec remains: Tlapa, to the east; Olinalá, to the northeast; and Zumpango del Rio, to the northwest, this last being the nearest and the most productive.

That these finds have not included permanent architecture or large-scale monuments should not negate the possibility that the local Olmec tradition was in a formative stage rather than the result of a peripheral, later extension of the culture. Both the nature and location of the Juxtlahuaca works, as well as their style and iconography, bear upon the dating. While a definitive answer can be expected only after further investigation, I am inclined to believe that the paintings and drawings were executed not later than the florescent phase of the Olmec culture, currently estimated to have lasted from 800 to 400 B.C. This does not necessarily mean that the cave's human remains and pottery fragments were contemporaneous with the paintings and drawings; they may very well pertain to an entirely different period.

Regardless of exactly where the Juxtlahuaca works belong within the context of the Olmec tradition, it is certain that they open a new and unsuspected field of investigation. They may eventually help clarify unanswered questions concerning the origin as well as the role of Olmec culture, which contributed so decisively to the art and history of ancient Mexico.



Partly hidden under flows of calcite, this picture is on the cave wall near Painting 1 and may depict a temple. If so, its perspective is distorted.



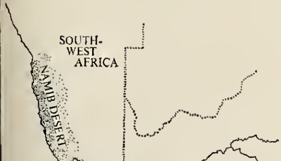
Immense and sprawling, this female Welwitschia *plant has persisted for centuries in its desert habitat. The species is dioecious: that is, male and female flowers are borne on separate plants. The plant is so weird taxonomically that it is usually placed in its own order—among the gymnosperms.*

By Willem Tijmens

FROM AN ANCIENT DESERT RELICT

Few plant species have attracted as many botanists from around the world as *Welwitschia bainesii*. This gnarled, ragged, extraordinary plant is endemic to the Namib Desert, a desolate, windswept region that stretches along the entire coast of South-West Africa and contains little more than sand dunes and diamonds. The plant not only thrives in such a harsh environment but attains remarkable longevity as well. Although not comparable to California's bristlecone pine (*Pinus aristata*)—one of which has been assigned an estimated age of 4,600 years and is now recognized as the world's oldest living plant—*Welwitschia* is a millennial species. I recently brought several pieces of trunk from the large individual at left to the United States for radiocarbon dating. Its age was established as slightly more than a thousand years. The plant was a mere seedling when William the Conqueror engaged his troops in the Battle of Hastings. Such vintage is particularly striking since the plant is not deciduous; its two leaves, split longitudinally by wind (making it appear that many leaves are present), are part of its original photosynthetic equipment.

Rainfall in the Namib Desert averages a scant two inches per year, but there are occasional stretches of two and three years when no rain falls at all. Under these circumstances *Welwitschia* obtains moisture from a 20- to 60-foot-long taproot and from sea mists wafting in off the Atlantic. These are sometimes heavy, especially in July, and undoubtedly enable *Welwitschia* seeds to germinate. However, it is flowering, not germination, that makes the plant troublesome to cultivate. The seeds normally germinate within three weeks after having been soaked, but it takes approximately twenty-five years for a plant to produce its first flower. Hence, to successfully cultivate *Welwitschia* in a garden or greenhouse, a grower must combine cheery optimism with an abiding patience. He should also be young enough.



Typical Welwitschia *country north of the Orange River is vast, dry, and barren. The karakul sheep that are found here serve as an index to the land's low productivity. To support itself, a single animal requires approximately 73 acres in which to forage. The region, however, s rich in another way—raw iamonds. As a precaution against nauthorized diamond hunters, irtually all travel in the Namib Desert is prohibited.*

TO MORE ELEGANT FLORAL RARITIES

"This land of Cape of Good Hope in farthest Africa no botanist ever had trod. Oh Lord how many, how rare and how wonderful were the plants that on this single day presented themselves to Hermann's eyes." So wrote Linnaeus on viewing what the Dutch physician and botanist Hermann had collected in 1680 in South Africa.

No one knows how many individuals of *Mimetes hottentotica* were in existence when Hermann visited the Cape. But in December, 1965, a helicopter expedition conducted by the botanic garden of the University of Stellenbosch in South Africa located and photographed what is believed to be the only surviving stand. Growing on a steep, misty slope in the cloud belt of the Hottentots Holland Mountains was a meager population of scarcely three dozen plants. Significantly, no immature plants were found. The species, if these indeed are its only remnants, is no longer reproducing. Precisely why is not clear. The problem is that very few seeds are produced, and those that do form either disappear (plucked, perhaps, by birds or mice) or do not germinate. The insufficient seed production possibly reflects a failure of cross-pollination. With so few individuals the chances of such pollination succeeding become slim indeed. The species, consequently, may have slipped below the numerical threshold required to maintain itself. The only trouble with so tidy an explanation is that it is not even known for certain whether *Mimetes hottentotica* is a cross-pollinator. The plant is so rare that collections for life cycle observations or cultivation experiments are prohibited. Collecting specimens at this stage, it is feared, might push the species over the extinction brink altogether.

It is estimated that the whole of South Africa has more than 16,000 plant species. Of these, 2,500 occur in a relatively

Since only 36 of these plan
are known to exist, the fragil
delicately colored inflorescen
of Mimetes hottentotica *is rarely see*
and more rarely photographe
Resembling tight clusters of kitche
matches, the styles—ranging fro
red through orange to yellow–
are individually surmounted by dar
tricornered stigmas. White, fur
stamens nestle among the plant
succulent leaves, which are covere
with a silvery pubescence. The enti
plant, usually classed as a shru
has an average height of six fee

Flowers of Leucospermum lineare–
which look like bursting fireworks–
are shown on the following two page
Characteristic of the gen
is a color change in the inflorescen
as it matures. Numerous style
still recurved in the flower at le
fringe the composite hea

Leucospermum crinitum *display perfectly the generic character of floral color change. Each flower head is in a different phase of maturation. The species grows in the western section of the Cape but, like* L. lineare *on the previous page, it is also extensively cultivated in both private and botanic gardens.*

narrow coastal strip fringing the southern tip of the African continent. This area, south of a line running roughly from Lambert's Bay to Port Elizabeth, contains the "Cape Flora," an assemblage of plants justly famous both because it is so distinct from the rest of the African flora and because it has definite family affinities with plants in Australia and South America. Such affinities have often been used in support of theories of continental drift. One aspect of these theories holds that a land bridge, perhaps through Antarctica, had previously connected Africa and Australia. A new element in attempts to explain the origins of this unique flora has recently been added by a Soviet scientist. In a letter to the director of the National Botanic Gardens at Kirstenbosch, the scientist claims to have found pollen of a South African plant in Siberia.

Putting aside the question of whether it originated in the north or in a supercontinent to the south, the flora today is showy, lush, and extremely diverse. For example, the Kogelberg Reserve—a vast tract covering some 60,000 acres in the Hottentots Holland Mountains—boasts the greatest per square mile concentration of plant species in the entire world. The abundance of certain families, notably the Iridaceae, the Ericaceae, and the Proteaceae, is also a characteristic feature of the flora. The proteas in particular are prominent and include, with the exception of the *Welwitschia,* all the species displayed in this article.

In spite of a general abundance, however, species like *Mimetes hottentotica* continue to be threatened and require special protection. A single anecdote will suffice to indicate how solicitous South Africans have become to protect their flora. A botany professor from a European university once visited a *Welwitschia* plant in the northwestern corner of the country. Fully cognizant of the enormous amount of time required to cultivate the plant, the professor decided to take a shortcut. He simply uprooted a "young" plant, tucked it under his coat, and proceeded to his hotel. After dining in his room, perhaps somewhat victoriously, the professor placed his new prize on one of the room's two beds and placed himself on the other for a good night's sleep. His rest was short-lived. The authorities showed up in the middle of the night, having been tipped off that botanic larceny was in progress. On gaining entrance, the authorities had to take but a step to the incriminating evidence, which lay carefully potted in the middle of the bed. The plant was confiscated and the professor arrested. After several weeks in and out of courts and jails, and after paying a substantial fine, the professor left the country—embarrassed and, presumably, empty-handed.

he largest of all the South African nembers of the protea family, Protea ynaroides *often produces flower eads that exceed a diameter of 12 nches. Its seeds must mature on the lant for at least a year in order to be iable. Such a long time increases the eed's exposure to danger in the wild; also complicates cultivation.*

Note to Gardeners

Packets of African seeds are distributed free to members of the Botanical Society of South Africa. The society devotes itself to preservation of the native flora, and membership is available at modest cost. On request, Natural History will send further details to its readers.

The Basques

Their language, their customs, even their blood provide evidence of a remarkable will to preserve their identity

by Morton H. Levine

Despite the leveling effect of modern communications, there remain in Europe a few populations that stand out from the surrounding peoples in language or culture or both. In France, the Bretons speak a Celtic tongue more closely related to Welsh and Gaelic than to French. The languages of the Lapps and Finns have no connection with those of the Scandinavians, and Hungarian is likewise unrelated to the neighboring Slavic, Romance, and Germanic tongues. These alien languages are islands of the Ural-Altaic language family of Asia in a sea of Indo-European. The most distinctive linguistic-ethnic enclave in Europe, however, is that of the Basques,

who live in the southwest of France and northwest Spain. Numbering fewer than a million, the Basques speak a language that has never been linked to any larger family. Many of their customs go back to the Middle Ages or earlier. And their biological character, as revealed in the unusual frequencies of certain blood types, is equally distinctive.

There are two mysteries about the Basques that have aroused considerable interest. The one that has stimulated the most widespread speculation concerns their origin. Where did the Basques come from? When did they arrive in their present hearth? With what other people are they affiliated? The other mystery is how, despite continuous contact with strangers, the Basques have been able to persist as a people apart during the two thousand or more years they have occupied their present homeland.

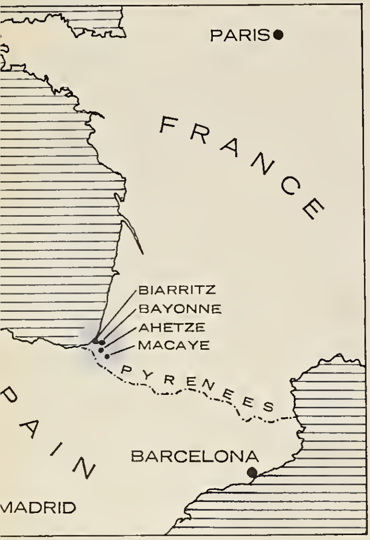
The curiosity about the Basques is well deserved. Their vigorous dances and traditional music, their oral literature now preserved in printed collections, their architecture, their well-documented values and customs all underline the difference between Basque culture and that of the adjacent French and Spanish populations. And their history is equally colorful. It was through the Pyrenean mountain passes of the Basque country that the battle between Charlemagne and the Saracen invaders flowed back and forth; the Basques proudly identify themselves as the mountaineers who cut off the rear guard of Charlemagne's army and brought on its destruction.

Although they are now among the most fervent communicants of the Roman Catholic church, the Basques stubbornly resisted Christianization and added a heroic chapter to the history of martyred missionaries before they embraced the faith. Even after Christianity was formally established among the Basques in the eleventh century, this savage people continued to trouble both civil and ecclesiastical authority. And even today, the Basque practice of Catholic ritual retains pre-Christian elements.

The Basque country lies astride the westernmost Pyrenees. Here the farms of Macaye, one of two villages studied, extend up into the hills. The yoked cattle, above, are still the principal beasts of burden among Basque farmers.

It was only recently that church authorities succeeded in suppressing the exuberant firing of a volley of rifle shots inside the churches during the celebration of Corpus Christi. Even so, the procession of the Host still includes a squadron of the youth decked out in military costume who enter the church dancing to the accompaniment of impressive martial music. While the origins of this unusual element in the celebration are not entirely clear, it is thought to derive from the ancient Basque custom of performing a dance in honor of a dead warrior chief.

It was neither their colorful history nor their mixture of ancient and modern custom that first evoked my interest in the Basques. Nor was it solely that their language, *Eskuara*, is apparently unique. This has long been known—even the Romans called attention to this queer tongue. More recently, however, another peculiarity of the Basques came to light, which, along with the several other distinctive characteristics of these people, pointed to them as a prime subject for anthropological study. This was the revelation that two common blood types were, respectively, less prevalent and more prevalent among the Basques than among other Europeans—and to a marked degree. In 1937 it was revealed that European Basques showed a much lower occurrence of type-B blood than their neighbors. Subsequent studies showed them to have less than 3 per cent of this blood type, compared with more than 8 per cent for the English and Belgians, almost 15 per cent for Germans, and more than 17 per cent for Italians. A decade later, beginning with a study of Argentine Basques, it was established that Basques everywhere have a much greater incidence of the Rh-negative blood type than any other people in the world. In one such study, for example, the Basques yielded almost 30 per cent Rh-negative compared with 17 per cent for non-Basque French. These biological discoveries indicate that the Basques have married among themselves to a considerable extent. Thus their inmarriage, their unique tongue that remains their primary language to this day, and their retention of so many ancient customs all evoked the question: How have these people been able to retain their identity for so many centuries, dating back at least to Roman times?



The will to preserve their identity is nowhere more striking than among the Basques of North and South America where they may well be more numerous than in the homeland. I observed this in visits among Basques in the western United States both before and after my three-year study of this question in the French Basque country. In 1960 I studied the marriage patterns of a Basque community in Idaho with the collaboration of Clifford Sather, a Reed College student. A few years earlier, a team from the University of Oregon had noted a significant drop in the characteristic blood-group frequencies for this population, indicating considerable intermarriage with non-Basques. We did, indeed, confirm this substantial mixture with non-Basques over three generations. But more impressive than this anticipated result was the extent to which the Basques assimilated their non-Basque marriage partners culturally as well as biologically. Everyone, regardless of origin, referred to himself as Basque. Clubs were organized, there were frequent folklore festivals, newly arrived relatives from Spain were teaching the children to speak Basque, and young adults who had

never seen Spain aspired to visit their ancestral homeland.

Last fall, after my return from France, I visited a small colony of immigrants, most of whom came from one of the two villages I had studied during the past year. This was another confrontation with the unquenchable desire of the Basque abroad to remain Basque. They came to a small California town at the solicitation of a French family to work in a local bakery. Well paid, their goal was to earn enough money to return home and buy a farm or establish a small business. For the farms of the Basque homeland in France are small and unable to support the typically large Basque family. Each of the families in this colony of 30-35 people firmly intends to return to France in a few years. They all live within a radius of three blocks of one another. They are content with minimal competenc in English and make no America friends. Among themselves they speak only Basque. And despite access to most of the comforts of American life, they are not beguiled b telephones, radio and TV, automobiles, and central heating. Their lif here is tentative, provisional, and entirely oriented toward that future o which they dream—the day they ar once again in the Pays Basque.

Here then are two examples of th powerful impulse of the Basqu abroad to retain his identity. Th

The Basque love to dance and are famous for the saut Basque, *or Basque jump, when both feet are off the ground at once. In church on Corpus Christi day, above, the congregation watches the entry of the youth in military costume—a mixture of pre-Christian custom and Catholic ritual.*

latest encounter was with first generation immigrants who truly expect to return, even though for some this may prove to be an illusion. Even more remarkable, however, was the earlier encounter with Basques who were permanently uprooted. It was actually this encounter with the Idaho Basques that stimulated the research I have been pursuing in Europe. There, too, one finds pressures for the assimilation and ultimate disappearance of the Basques as a linguistic, cultural, and biological entity—an isolate. But much of the traditional culture remains, and its recent evolution may be studied. The language, at least in France, is universally spoken; one could, therefore, study the phenomenon of the Basque isolation at a stage where the deterioration of this isolation is less advanced, and where nostalgia and pride are not yet wholly a substitute or reality.

The Basque country lies astride the westernmost Pyrenees Mountains and along part of the Atlantic coast of France and Spain. Basque place names are found beond the present hearth, indicating hat they once occupied a more exensive area. More than half a million Basques now live on the Spanish side f the mountains, where the Pais asco has become a major industrial, ining, commercial, and shipping enter, as well as a region of farmers and fishermen. Less than 200,000 inhabit the socially, culturally, and economically more homogeneous French provinces. It was in the less complex and more conservative Pays Basque of France that I undertook the study of Basque isolation.

A people may be said to be isolated in one of two ways: either geographical barriers have cut them off from contact with other peoples, or they have cut themselves off from their neighbors by cultural and linguistic barriers. It is the latter that appears to account for Basque cohesion, even though they do live in a mountainous region. For the Pyrenees in the Basque country are hardly formidable, and they are intersected by many passes through which the Basques have long conducted a lively traffic in contraband. Historically, this section of the Pyrenees has been a veritable highway between France and Spain since pre-Roman times. Indeed, the sole evidence for the presence of the Basques in the area between pre-Christian times and the Middle Ages comes from the annals of the Romans and others who encountered this savage folk. Thus, if the Basques have remained an isolated enclave, it has not been because geographic barriers have denied them contact with others.

Nor are the Basques an isolate in the sense that they have never borrowed anything from alien tongues or foreign cultures. It is estimated that the contemporary Basque vocabulary contains three-quarters borrowed words, going back at least to Latin and probably to Celtic. If this last be true, the Basques would have been neighbors of the Celtic tribes who occupied the Iberian Peninsula before the Romans. As to other cultural borrowing, many customs identified today with the Basques are not aboriginally Basque, but are the retention of customs that were widespread during the Middle Ages and that have been retained by the Basques while abandoned by others. The colorful *Masquerades* and *Cavalcades* that today seem so characteristically Basque are but their retention, in somewhat altered form to be sure, of the medieval miracle and mystery plays.

If this assimilation of alien linguistic and cultural elements is so much a part of Basque history, may not their apparent isolation be illusory? One of our aims is to answer this question with some precision, but even now we can partially resolve the seeming paradox of linguistic and cultural borrowing on one hand and isolation on the other. Once we go behind the gross facts of encounter with other people, borrowing of words and adoption of alien cultural elements, we find this: the Basques may have adopted foreign words, but their grammar and the characteristic sounds of their language have remained intact. They

With stoic co-operation, almost all who were asked gave their blood for the analyses made during the study.

may have borrowed customs from others, but they have also tenaciously retained customs that others have abandoned. They may have had contact with other peoples but, as the biological studies indicate, they did not intermarry with them to a significant extent. All this suggests that isolation is a complex phenomenon indeed. It is surely not an all-or-nothing proposition. Few, if any, peoples have ever been absolutely isolated for any length of time. Not only is isolation a matter of degree, but it has more than one aspect. Borrowing words may or may not entail adoption of strange customs, and neither linguistic nor cultural adoptions necessarily involves genetic borrowing. Further, the rate of borrowing may vary from one epoch to another, and the presence of medieval cultural elements in present-day Basque culture would indicate greater isolation since the Middle Ages.

To study this phenomenon in the field we were confronted with a challenge: In order to study Basque isolation, it would be necessary to breach that isolation. My wife and I visited the Pays Basque in 1962 to reconnoiter the area and consult with local experts and authorities on the feasibility of the study I had in mind. When the research design was developed in detail, we returned to the region and drove some 6,000 miles, mostly back and forth through the tiny westernmost province of Labourd, seeking two villages with no more than 500 inhabitants each, both supposedly "pure Basque." I sought one in which the inhabitants had little or no contact with non-Basques as a rule and another where such contact was common.

The search was complicated by the requirements of size, appropriateness to the research, and the need for virtually guaranteed co-operation from the three most important figures in any Basque village—the mayor, the priest, and the doctor. It was only toward the end of a very long summer, and after many encounters with the stony face of Basque reticence, that we found the two villages of Ahetze and Macaye where we were to devote more than a year to the field study of Basque isolation.

Ahetze is located in the gentle rolling upland that overlooks the Bay of Biscay coast, three miles along a country road leading from the main coastal highway between France and Spain. Macaye is about twenty-five miles inland, not far from the ancient frontier between Labourd and the central province of Basse-Navarre. Like Ahetze, it is a few miles off a main highway and is reached over a local road. Neither village would be passed by the traveler on a through journey, and both are reputed to be pure Basque villages.

The differences between the villages are as significant as their similarities. Despite the increasing penetration of the interior by Frencl tourists during the summer, Macaye's inhabitants encounter fe non-Basques. Except for a minimun of commerce—two groceries, thre cafes, and several artisans—the basi occupation is farming and herdin The two telephones in Macaye are i two of the cafes.

Ahetze presents a different pictur While farming and herding are tl principal occupation, a significa part of the community works in tl industrial-commercial complex Biarritz, six miles away, and B yonne, ten miles distant. In the i terior village of Macaye, where tl small family holdings can no long

Blood donors ranged in age from 20 days to 90 years, but the younger ones were the most cheerful and amenable. The woman above watched all her neighbors give before she guardedly consented to donate.

support several generations of a fam- ly, young people tend to emigrate.)ver thirty *Macayards* are currently iving and working in the United tates. In Ahetze, the young people an work in the nearby urban zone nd still reside in the village. Thus, hetze is penetrated by the culture of he city and of the world beyond the ays Basque with its own people as arriers. This is a community in tran- ition, in the process of assimilation nto the urban or at least sub-urban orld. There were thirteen tele- hones in Ahetze when we left, with ore to come in the near future. hetze and Macaye may only be sep- ated by twenty-five miles, but it is better measure of the distance be- een them to say that Ahetze is enty-five years from Macaye along e road to urbanization.

When my wife, a student assistant, and I arrived in the ys Basque in the summer of 1965 r the major part of the study, which uld encompass a field season of at st a year, we brought an an- opological shopping list of for- dable proportions. The general n was to study each community m the point of view of its social ucture, its biological makeup, its ent history and, above all, from standpoint of its relations with the outside world. Thus, it was hoped, we would be able to measure the several dimensions of isolation.

To begin with, we made a complete census of each village. We sought the genealogy of each family on both the male and female side for five generations wherever possible. The census would give us individual life histories of a sort, but the genealogies were required to establish for each village the geographic and cultural radius within which they married. Apart from personal histories, we took the description and history of every property holding in each village, seeking the names of the past four proprietors and their relationship, if any, to the current owner. All this data would give us a picture of the population movement into and out of the village over a respectable period of time and would, above all, pinpoint the origin of such immigrants as we found.

Then, we sought data on the web of economic transactions in each village. What kind of products are brought into the village, how are they obtained, and from where? What part of the products of agriculture, stock raising, and artisanship are put on the market? How? And where? In short, we sought data on the extent and intensity of economic exchange for each village.

Further, there were data to be gathered on habitual and unusual travel, on ownership of personal transportation (cars, bicycles, and so forth), on subscriptions to newspapers and journals, on memberships and affiliations in organizations of various kinds, on radio and television ownership, and even on the flow and destination of mail from the community and source of mail coming into the community. This was to give us the cultural "reach" of the respective communities, its range, and its quality. And, we wanted to examine the extent of involvement with the outside world, to characterize the articulation of individual villages with the larger regional and national political structure.

This was by no means all of the shopping list. The populations of these villages are first and last Basque speakers, but not always. We wanted to find out when people spoke Basque and when French, and the extent to which the Basque language was used as a means of guarding and enhancing their separateness. We wanted to learn about education and child-rearing practices to understand to what extent the present youth are brought up with a high level of Basque consciousness. In this connection we elicited essays from the school children of varying grades on such topics as "The career I want to pursue when I am an adult," "What is a stranger," "What is a Basque."

Of all the things we demanded of these two villages, perhaps nothing was as exigent as that which we needed to establish the biological character of each village. We asked for medical histories, data on infant mortality, physical measurements of almost the whole population, and, finally, we wanted a blood sample from as many people in each village as possible. By the time we left, we had taken four tubes totaling 40 cc., from 730 out of the 960 residents of Ahetze and Macaye. The age of our subjects ranged from 20 days to 90 years. The blood was taken by the staff of the Centre Départemental de Transfusion Sanguine at Biarritz, which also performed the control analyses for the A, B, O, and Rh blood types as well as medical analyses of blood sugar and cholesterol. The larger part of each sample was packed in ice and shipped to the Centre d'Hemotypologie of the French National Center for Scientific Research in Toulouse. Here the superbly equipped laboratories made some 68 analyses of genetic significance and froze part of each sample for storage and future analysis.

To come with demands like these to any population depends a great deal on support and advice. Our two previous visits had acquainted us with widely respected experts and authorities in the Basque country who gave us their endorsement without reservation. The leading figures in both villages, as well, did everything they could to advise us on procedure and prepare the people of their communes. Perhaps the most important contribution to our success in penetrating the villages and obtaining the co-operation of this notoriously reticent people was their own awareness of their status as the survivors of an ancient people of unknown origins.

In the only cafe in Ahetze, these men enjoy the aftermath of blood giving: a repast with wine from sponsors of the study; children got chocolate.

Even so, it was not easy. Not only are the Basques resistant to strangers, but they are fiercely individualistic and libertarian and do not often co-operate en masse. After all the introductions and endorsements we could get, we still had to conquer these villages house by house.

On one occasion, not long after my arrival, I was standing on the threshold of a Basque house and explaining the program of work to the young matron. I was hardly through before she asked, "Is it obligatory, monsieur?" To which I replied, "Nothing is obligatory, madame, not even to talk to me." At which point she invited me in to talk.

Our investigations, as might be expected, went beyond the original plans. We also achieved a head start on studies of Basque values, religion, and ceremonial, and on Basque nationalism, which is currently seething in Spain and simmering in France, in behalf of the unification of the three French and four Spanish Basque provinces into an independent nation. This will have to await our next study. Meanwhile, sorting and analyzing the data that relate directly to the present research will require many months. We now have only some tentative conclusions about the Basque status as an isolate.

First of all, it seems quite clear that Basque isolation, to whatever degree it may exist, is a function of the will of the Basque people and is not something that the surrounding non-Basques have imposed upon them. The Basques are not outcasts.

The principal weapon deployed by the Basques to guard their separateness is their language. In the villages I studied, it is always the language of the household, the language of intimacy, and the language spoken before strangers when there is something to talk over or comment on among themselves. They have, therefore, a means of maintaining their privacy when non-Basques are present. It is an option they use often.

The Basques love to say that it is difficult, indeed impossible for strangers to learn to speak Basque. The curé of Macaye delighted in the ancient and oft told story that the devil tried for seven years to learn Basque and hurled himself from a bridge in vexation when, at the end of that time, he had learned only the words for "yes" and "no." These admonitions about the impossibility of learning the language were inevitably delivered with a certain pride and even pleasure. It finally occurred to us that these widespread views that held it impossible for a foreigner to learn Basque were perhaps just another expression of their resistance to penetration.

There is even internal isolation within the Basque country. It has long been known that there are more than twenty-five different Basque dialects, some of them mutually unintelligible. This in itself bespeaks considerable segregation. I also learned that, while there is much contact between French and Spanish Basques among scholars, professionals, and politicians, there is very little contact between the broad masses of people.

Urbanization along the French coast and the acceleration of tourism are responsible for an increasing penetration of the Basque enclave by foreign elements. In addition, motorized bicycles have made the Basques themselves far more mobile. These vehicles were introduced after the Second World War, and the intensity of travel between the interior and the coast has increased steadily. Only an analysis by generations of the radius within which marriage partners are sought will tell us how much this has broken down internal isolation.

Perhaps the strongest single contemporary force for the retention of Basque cultural tradition is the church. All priests in the Basque country are themselves Basques and Basque speakers, and they encourage the conservation of the integrity of the local community. When the liturgy is finally rendered in Basque, following the mandate of Vatican II, the conservative role of the church will be enhanced.

Aside from what I learned about their isolation and other aspects of Basque culture and history, however, I also gained a more precise appreciation of what remains to be studied. A systematic archeological survey of the Basque country should be undertaken in the near future. There is an enormous gap between what we know about Paleolithic times in the region and that known about the much later time of the Celts and Iberians. Only archeology can satisfy the question of whether the Basques occupied their hearth since the Old Stone Age or whether they came in at some later time. This is the big question of the "origins" of the Basques. Perhaps they are indigenous as far back in time as it would be useful to study. And, since Basque place names suggest they once occupied an area extending farther to the north and to the south, they would, if they were the Stone Age inhabitants of this region, have been the decorators of caves like Altamira and Lascaux. All this remains to be determined.

As to isolation, I am convince that the experience of penetratin two Basque communities was a informative about their will and capacity to remain apart as the precis data described above. The anthropo ogist, as the stranger par excellenc an alien in the village, wanted t enter every house and ask for famil histories and other kinds of inform tion that would be hidden from a ta collector, and in the end he asked fo their blood. He finally got all thi and many affecting signs of frien ship. But there are layers of intima as stratified and profound as th levels the archeologist digs. Only t first few of these have been reache

Sheep raising is still the mainstay the Basque economy. During the su mer months these sheep are herded high ground to graze.

THE CHAMELEON

by CARL GANS

From its grasping tail to its projectile tongue, this grotesque product of evolution is a complex of modifications, which allow it to hide, glide, hunt, and prosper in an arboreal environment

Virtually everything about a chameleon is remarkable—the shape of its body, its tail, and its head; the head's display of weird crests, flaps, and perhaps horns; and the anatomy of the strange eyes and the equally strange tongue.

The makeup of this animal includes few components that do not show a high degree of modification or specialization. But a zoologist is not satisfied with a catalogue of peculiarities. He knows that natural selection favors any change that is advantageous, so he wants to discover the advantages of these peculiarities. In the life of a chameleon they are complexly fitted to a distinctive way of making a living in an arboreal environment.

Any of several adaptive modifications may permit a lizard to live in trees and bushes. It may specialize for running, jumping, and even gliding from branch to branch. It may develop rapid flight reactions, which allow it to escape into the canopy or into crevices in the bark when disturbed. Since almost all lizards are carnivorous, it may specialize in surprise and capture its insect prey by the stalk-and-dash technique.

But chameleons utilize none of these techniques. Although these animals probably derived from more typical, ground-living lizards, their modifications occurred so long ago and were so drastic that all authorities now agree chameleons belong in a group by themselves. More than fifty species have been recognized, and these inhabit an amazing variety of habitats, from dry lowlands to humid, high-altitude rain forests, from Ceylon to the Mediterranean and southward over most of Africa to the Cape. In some situations they are so astonishingly common that one can pick them off the bushes almost as if they were berries. Thus, their departure from the structural and behavioral pattern of other lizards appears to have been part of a highly successful adventure.

The key to this success lies in the chameleon's adaptation to life on the smaller branches and twigs of bushes and trees, and more specifically, to a slow-motion existence in this adaptive zone. Not only is this the kind of environment where most of the species are found, but it also provides the best explanation for the assorted chameleon characteristics.

A chameleon body, for example, is short but high and compressed laterally. Where the legs of other lizards project laterally, those of chameleons pass immediately downward from the points of their girdle attachments. As a result, the animal can place all four of its feet in line on the same twig. This permits it to move along slender branches without too much overlap on either side.

Of course, a tall, narrow body causes problems of balance. Few twigs are both steady and horizontal, and gusts of wind add to the difficulty. Therefore, it is not surprising that a leaflike body shape occurs only in animals that can maintain their stability by other devices. Chameleons do so. They stabilize themselves both by their curved prehensile tail and by the opposed toes of their feet. Other lizards have prehensile tails, but few can match the grasping curve of a chameleon tail when it rolls into a platelike coil (not a corkscrew). When the animal is moving slowly or crossing a wide gap between twigs, the tail is first stretched out straight back, then swung downward in a searching movement. When a stem or small branch is touched, the tail wraps around it, grasping it firmly. This grip can be remarkably strong. Chameleons intent on catching prey have been seen to slip, then complete the capture of a fly while suspended only by the caudal coil.

The tail is not needed to support the animal when it is walking slowly along an ordinary branch; the feet provide excellent support. The chameleon has opposed digits, rather than fingers and toes that spread out in a radial pattern: the posterior three fingers form the outside and the anterior pair form the inside of the hands; on the feet the two posterior digits are on the outside and the anterior three are inside. This arrangement is less efficient for manipulation than the division of the primate hand into thumb and four fingers. Yet, since the motion of chameleon hands and feet is restricted to opening and closing, it provides an excellent, foolproof clip arrangement. This aspect is especially important because the chameleon apparently places its feet, like its tail, by a kind of search, contact, grip pattern; it does not always "watch where it puts its feet."

ie turret-like eye stares ahead
prey while the other swivels to see
here is danger at the rear.

The general problems of footfall pattern and of how each foot is placed, of travel rate, and of tail manipulation lead to more questions than answers. For instance, a chameleon's progress along a branch may be not only slow but erratic. The animal is apt to rock back and forth and wobble slightly from side to side. This often gives the impression of an elderly gentleman attempting to maneuver a narrow walk after a "night out with the boys." Other individuals move in a more constant manner, but even so it is not clear when the erratic movement cycle may occur or what its meaning might be. Some of the complexity of foot placement may well relate to the chameleon's lack of visual control; when reaching out, while supporting itself on its hind legs and tail, an animal has been seen to grasp its left foreleg with its right forefoot and to hang there for ten minutes before it disentangles itself.

There is some presumptive evidence that an entirely different aspect of the locomotor apparatus also deserves some attention. The animals may remain off the ground for days at a time. During this period they sleep resting on branches, a position in which the feet must maintain their grip. Chameleon feet, unlike the feet of certain birds, lack an obvious locking device that maintains the grip mechanically. It is not clear whether the chameleon's muscles contain fibers that permit prolonged contraction or whether the animal solves its problem some other way.

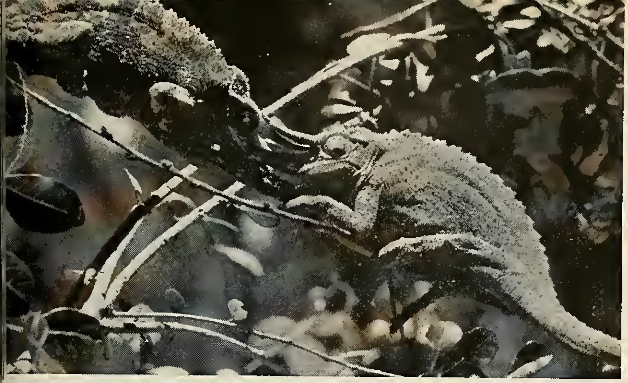
The peculiarities of the body shape also require further explanation. Several factors may account for this specialization. First of all, a narrow body allows for placement of the legs directly beneath the trunk rather than to the sides; this, we have seen, is essential for travel along single twigs. Also, narrowness and tallness are useful when an animal has to pass between the leafy twigs at the tips of branches. Perhaps the most important advantage of the curious shape is the modification of the animal's outline when seen from front or side, an aspect increased by the various dorsal combs and similar projections. This outline may reduce the chance that the animal will be recognized as a lizard by birds or other sight-hunting predators.

Equally important, when the chameleon itself hunts prey its slow-moving shape allows it to profit from camouflage—cryptic (concealing) coloration in various shades of green and brown, markings that resemble leaf ribs on the sides of some chameleons, and radial markings on the head that effectively hide the eyes of other species.

Obviously, we require some knowledge about this creature's environment to interpret its color pattern correctly. The literature contains many denials that a particular coloration could possibly be cryptic, but these statements were generally accepted only until someone observed the animal in the wild. The small chameleons of the genus *Rhampholeon,* for instance, generally have a brownish coloration and a short, non-prehensile tail. These characteristics suggest a non-arboreal existence, and field observations confirm that the animals spend at least part of their life on the ground. Some species of this genus inhabit relatively open country, where the scrub vegetation turns brown and loses its leaves during the intermittent dry season. During such periods the animals may be found under rocks.

Then, too, the coloration of chameleons is notoriously changeable. The mechanism that induces such changes is still being investigated. We know, however, that the chameleon does not immediately change color when, for instance, it moves from a green to a brown background. Thus, it is less efficient than the flatfishes, whose change of color is spectacularly precise and swift. The chameleon mechanism operates on a more statistical basis; a general color matches a particular portion of the animal's environment. There are exceptions, of course. Some species show specificity, and at least one form shows variations in the females, of whom about 80 per cent are basically green, while the rest are brown. Notable exceptions also occur when individuals are frightened, are otherwise disturbed, or are in artificial environments.

The head ornamentation of chameleons should make them ideal candidates for roles in horror movies when the script calls for a prehistoric monster. It is usually the Central American iguana that is used—but the chameleon would be far better casting. Its skull is edged with sharp, projecting cornices and folds. Some species combine these with movable dermal flaps along the skull's posterior edges, while others have one, two, three, or four pointed or leaf-shaped horns. The pointed



These photographs show that interactions of chameleons are not limited to menacing gestures when two meet on the same branch. Far left, they approach with bodies inflated, using their tails as well as feet to keep their balance. Next, they assault with their horns while straining to dislodge each other. Below, as it falls, the loser grasps at a twig with its prehensile tail.

horns have a bony core covered with connective tissues, skin, and a continuously growing cap of keratin, or horn. They are never shed, making them the structural equivalent of cattle horns, but not one of the standard anatomy textbooks mentions them. Even the classical, eight-volume German *Handbuch* of comparative anatomy discusses only the horns of mammals. This neglect in the anatomical literature seems to reflect the assumption by some zoologists that such odd and variable structures cannot have a function. It remained for Dr. A. S. Rand, now of the Smithsonian Institution, to show that these structures, which sometimes differ between sexes, probably evolved as devices for sex recognition and territorial defense.

Dr. Rand's hypothesis agrees with a number of miscellaneous observations in the literature—the kind of incidental information that the zoologist must often use to help him plan more effective experiments. It is known that captive chameleons tend to occupy specific sites on individual branches, to which they return in the evening. There are even reports concerning interactions of individuals in the vicinity of such stations.

They tend to meet head on, to bob, puff, and display; but only recently have reports appeared of actual physical contact, even of fighting behavior involving the horns. Two males may approach each other on a branch and, after a period of display, interlock their horns and strain to displace one another. Moreover, it is clear that chameleons are basically unsocial animals. They react negatively to each other and, like many other lizards, tend to be disturbed by

Especially grotesque are the horned species of chameleons. Their horns, like those of cattle, are never shed.

crowding. The entire area of social interaction between lizards. although highly interesting, is only now receiving the attention of investigators.

Of added interest are the various devices that make the animal appear larger when viewed head on. In an encounter between chameleons, flaps back of the head are erected by muscular action and the throat is inflated, as is the trunk of the rest of the body. Some researchers conjecture that inflation of the trunk is assisted by the curious lung structure found in most chameleons. Unlike the relatively smooth lungs of other lizards, the lungs of these chameleons have a varying number of blind diverticula, or dead-ended tubes, that project from the sides of the main sacs and pass between the other visceral organs. Inasmuch as no other function for these diverticula is yet known, it may be that their job is to puff out the trunk.

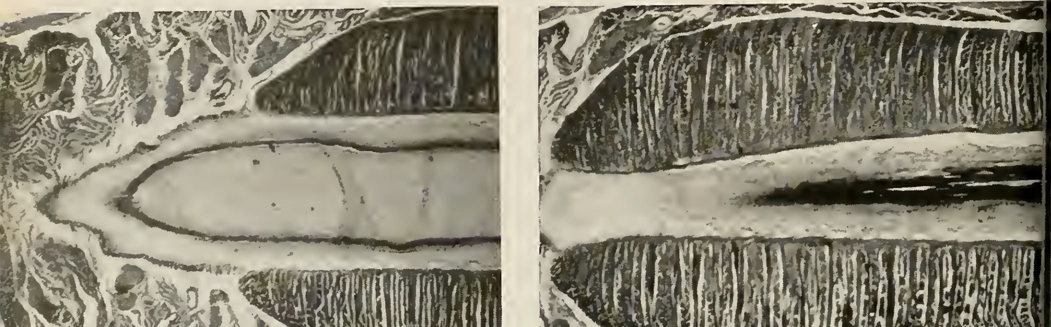
The projectile tongue and the eyes —its two main hunting devices—are perhaps the most remarkable aspects of the chameleon's equipment and provide information that governs the tongue action.

The bulging, cone-shaped eyes are formed of modified and fused eyelids, with the eye proper peeking out of the tip, and they are structurally distinct from the eyes of other animals. Their action is as fascinating as their structure. Aiming the eye is not done by shifting the eyeball itself; the entire cone, with the eye at its apex, swivels like a gun turret as the animal scans its surroundings.

Most interesting, not only to the casual beholder but to students of vision, is the complete independence of the two eyes. Because man is an animal with stereoscopic vision, the visual fields of his two eyes overlap. We tend to assume this is also true for the rest of the animal kingdom.

Even when we realize that the left eye of a carp or of a garter snake cannot possibly see any part of the field seen by the right eye, the concept of independence remains a bit esoteric for most of us—until we observe the chameleon keeping a possible predator in hind view with the right eye, while tracking the passage of a fly past its nose with the left eye. Actually, chameleons have the best of both worlds: independent eye movement and stereoscopic vision. Although the stereoscopic field is relatively small and lies immediately in front of the animal's nose, this is the zone into which the tongue may be directed—the area in which range finding is most important.

The entire apparatus is ideally



Tongue components are seen in four enlarged photomicrographs. First picture: (left) folded retractor muscle; (right) dense mass of accelerator muscle; cigar-shaped portion is cartilage—the hyoid horn—within a hollow tendon. Slice shown in picture above misses hyoid, shows more of the accelerator.

itted to the needs of a slow-moving redator—an animal that can neither un down its prey nor catch it in a urprise dash. But the chameleon is tself preyed upon, and it relies on nore than its cryptic appearance to scape the attention of predators. ne eye can keep a lookout and delay he attack upon prey until disturbing bjects have passed.

While the eyes of the chameleon pparently represent a departure rom the visual systems exhibited y other vertebrates, its projectile ngue seems similar to those of any animals that use the tongue to atch prey. But this resemblance is perficial; the principle is entirely different, and its mechanism has been a source of considerable confusion over the past 150 years. An important muscle physiologist of the last century tried to explain the tongue's method by a now-questioned hypothesis of muscle action, and during the early 1930's three scientists—a German anatomist, a Netherlands physiologist, and a histologist from India—arrived at three totally distinct functional hypotheses by limiting themselves, respectively, to investigations of the anatomy, the physiology, and the histology of the tongue. None of the hypotheses is entirely right or completely wrong; their diversity indicates the difficulty of the subject matter.

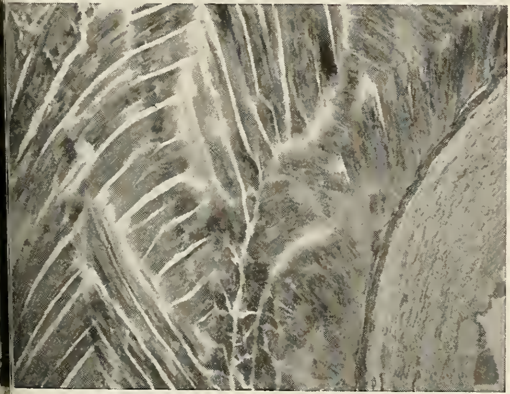
It is now possible to take stroboscopically exposed motion pictures of the prey-catching process. By this method we are shown the exact kind and sequence of motions the animal uses, allowing us to decide among some of the conflicting statements in the literature.

How does the chameleon protrude the fleshy, sticky tip of its elastic tongue, then fire at the prey so successfully? Although the animal will strike at close prey, its tongue can easily shoot out as far as its body is long, and even as far as the length of its body plus its tail.

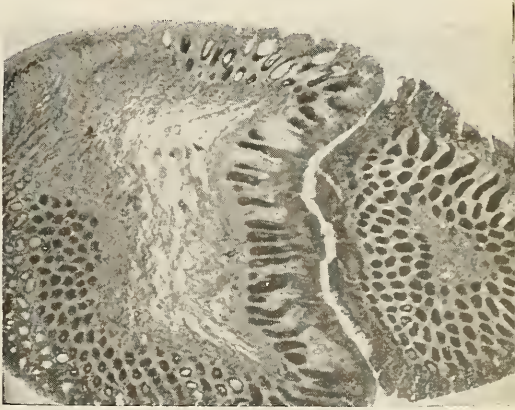
This tongue, with the hyoid structure that forms its basal support, and with two important sets of tongue-operating muscles, one at the front and the other at the rear, is a complex mechanism. In essence, here is the sequence that ends with the chameleon snapping the prey back into its mouth.

First, of course, there is the visual stimulus provided by the prey. This starts the nervous response. The animal's mouth opens slowly, as if beginning to yawn, and the tongue apparatus advances, somewhat like an artillery piece on its carriage. The "barrel" is a thin cartilage within the tongue. The soft tissues of the tongue tip form a cap over the front end of this spikelike cartilage—the anterior horn of the hyoid. When at rest, its rearmost portion reaches below and beyond the back of the skull, where it is connected to a lever system of other cartilages. When responding to muscular contraction in that region, this hyoid horn, with the tongue tip it carries, is lifted off the floor of the mouth and moved out.

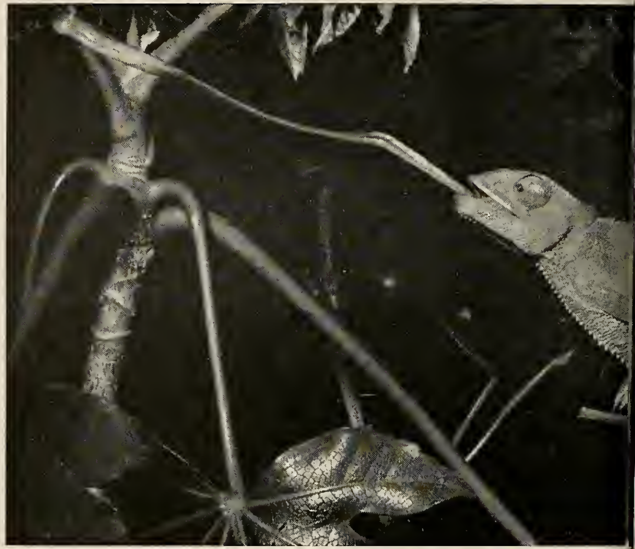
It was once believed that the front end of this horn first moves rapidly, then stops, and that the tongue tip continues outward under its own inertia. But in 1934, using anesthetized chameleons, it was found that directly stimulating the powerful "ring" muscle at the tongue tip would shoot it forth—even when the hyoid horn was held fast in a vise. My recently taken motion pictures, exposed stroboscopically, have added details. They show this sequence: the mouth opens; the hyoid tip with its



This is a cross section through the back of the tongue proper. Densely packed fibers of tendon (right) are next to crisscrossed fibers of the accelerator.



At the tip, glandular tissues provide sticky secretion that helps hold prey to the tongue. In this horizontal slice, the "dimple" seems to divide tongue in two.



After a strike, the tongue's knobby end begins its return trip. Thin portion behind it is retractor muscle and tendon. Part of firing mechanism's hyoid remains out of the mouth.

covering tongue protrudes relatively slowly (in from ¼ to ½ second); then the tongue darts forth. In less than 1/25 second its flipping tip can strike a relatively distant fly. So we conclude that the hyoid horn cannot provide the sudden acceleration; rather, it brings the tongue out of the mouth and positions it for the strike.

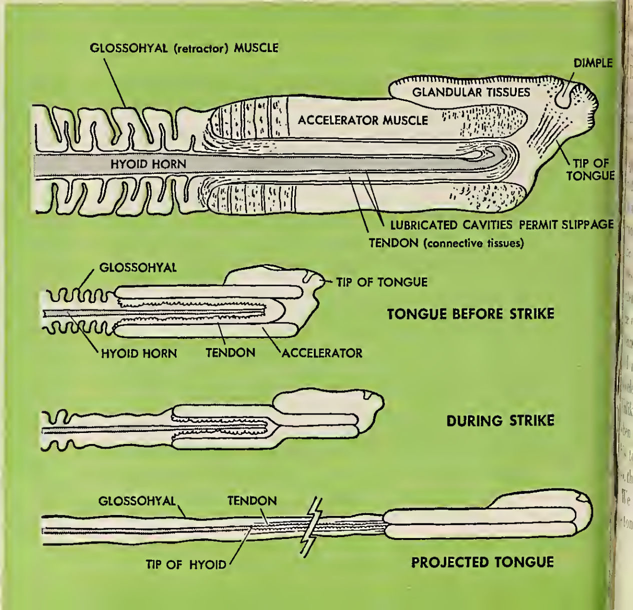
This has additional value. The tongue must already be protruded, for otherwise friction would slow the flipping action. Secondly, protrusion facilitates aiming, which seems to require that the chameleon point its head in precisely the correct direction of the target. And, of course, pointing the head means that the animal's protruding, centered tongue will be aiming in the same direction, ready to be fired straight out from the mouth.

Meanwhile, the bizarre pair of eyes are doing their work. One eye keeps the prey in view and guides an approximate corresponding adjustment of the head; the other ranges about, scanning other objects. Then this second eye, focusing on the prey, helps with a last-moment adjustment of the head's aim.

After aiming, how is the tongue fired? Much is now known about the mechanism that prepares the way for the actual flipping. Anatomical studies show that the chameleon tongue contains two important muscles (*drawing, right*). One is the accelerator, the powerful ring muscle, mentioned previously, which shoots out the tongue. The other is the accordion-shaped glossohyal, which will later bring the tongue back with the prey adhering to its tip.

The accelerator, shaped like a covering knob around the front end of the hyoid horn, and linked to it by the folded connective tissues of a tendon, accounts for the tongue's club appearance there. This muscle's fibers are peculiarly arranged. Most of them appear to connect radially to the relatively thick and inelastic internal membrane of the muscle. From here the fibers curve either left or right, in small groups that cross each other and go on to connect tangent with the surface of the external membrane.

We know now that the contraction of this accelerator muscle exerts a sudden, high pressure on the entire surface of the tapering, slippery hyoid horn. The result is different from what one might expect—for example, when one's fingers squeeze a


GLOSSOHYAL (retractor) MUSCLE
DIMPLE
GLANDULAR TISSUES
ACCELERATOR MUSCLE
HYOID HORN
TIP OF TONGUE
LUBRICATED CAVITIES PERMIT SLIPPAGE
TENDON (connective tissues)
GLOSSOHYAL
TIP OF TONGUE
TONGUE BEFORE STRIKE
HYOID HORN
TENDON
ACCELERATOR
DURING STRIKE
GLOSSOHYAL
TENDON
TIP OF HYOID
PROJECTED TONGUE

Prey-catching sequence: (top) thin hyoid horn will carry the elastic tongue out of the mouth; accelerator will fire it; glossohyal will bring it back. Next three sketches show stages of the projectile action.

slippery seed, the seed pops out. But here the hyoid horn remains, the surrounding knobby portion of the tongue is projected forward at high speed, and the tongue's inertia carries it to the prey.

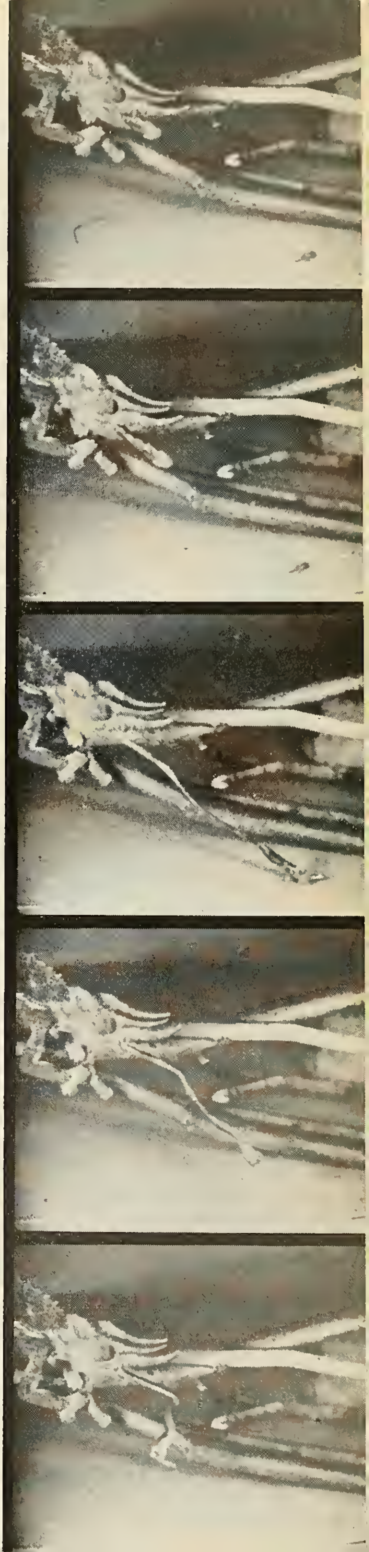
It is by shortening the outside surface of the accelerator muscle that the crossed fibers cause compression of fluid inside this muscle, thereby producing the required sudden high pressure on the tip of the hyoid horn. (In other animals such internal pressures come from circular and helically arranged fibers—sphincters.) There are two reasons why the chameleon's peculiar muscle may be advantageous. First, the hyoid horn's angle of taper is relatively small; so applying the pressure suddenly is not sufficient. The squeeze must continue as long as possible—until the hyoid tip is left behind. Secondly, the distributed rather than localized pressure prevents binding that might interfere with forward movement of the connective tendon. This second connection between tongue and hyoid runs between the back of the accelerator cap and tip of the hyoid. Unlike most tendons, it is hollow; when the tongue shoots off the hyoid, this tube must be free to slide off too, then stretch, and turn inside out.

We now move to the soft tissues of the tongue tip, which form the actual prey-catching mechanism. They are arranged in an involved pattern of folds and ridges with multiple mucous glands emptying into the intervening spaces. When at rest, the center of the tip's contact surface looks like a dimple. The sides and bottom of this area are only loosely connected to the rest of the tongue tip. When the tongue strikes a large insect, this dimple flattens out and comes into contact with the obstacle. This contact, plus the mucus, supplies the cohesive force that holds the prey to the tongue on the return trip.

The return is handled by the other major muscle of the tongue, the glossohyal. Located just behind the accelerator, it surrounds the hyoid horn in an accordion-pleated pattern. When the tongue is shot out, it unfolds the glossohyal and carries it along with the connective tendon, in much the same way that one plays out a coil of rope.

After the tongue tip has reached the prey, contraction of the glossohyal begins; its backward pull brings the tongue back onto the hyoid horn. This sequence has been confirmed by physiological experiments; we no longer believe that the glossohyal acts like an arm pulling back on a bow string, and that relaxing it lets the tongue shoot forth.

The return trip is not entirely simple, however. The small muscle fibers at the tongue tip play an important role. They must produce a sure hold on the prey because the return is both slower and more complex than the dazzlingly fast and direct outward path. Motion pictures show that the tongue is only gradually drawn back onto the hyoid horn. Meanwhile, its fleshy tip swings downward and back, once or twice, like a pendulum. How long this retraction process takes obviously depends on the weight of the captured food. In any event only seconds after swallowing its prey, the chameleon is ready to fire its remarkable tongue again.



Projectile tongue in action: interval between each of author's stroboscopically exposed frames is 1/12 second. From top, first three frames show chameleon firing at a mealworm. In next two, the tongue returns with dangling prey.

SKY REPORTER

Beginning with this issue, "Sky Reporter" presents two new monthly sky charts, specially prepared by Helmut K. Wimmer, Planetarium Staff Artist, from data provided by Dr. Thomas D. Nicholson, Chairman of the American Museum-Hayden Planetarium.

THE MONTHLY STAR MAP

The "Sky Reporter" star map for each month shows the stars that can be seen from latitude 40 degrees north at about 9:00 P.M. during the early part of the month. Rather than use separate symbols for stars of different magnitudes, the map distinguishes among brighter and fainter stars by the sizes of the images used, in order to represent more closely the visual appearance of the sky.

The part of the sky shown on the star map matches the sky that would be seen from the earth's surface looking up. Thus the map matches the entire sky only if held overhead, with north facing toward the North Star (Polaris). In this position, the center of the circular map represents the zenith—the point in the sky directly overhead—and the circumference of the map represents the horizon, with the compass points of the map matching those of the horizon.

A more convenient way to use the star map, however, is to hold it vertically in front of you, with the compass direction you are facing at the bottom of the map. Thus, if you face north, hold the map with north at the bottom, and the stars on the *lower half* of the map will match the stars that you are facing in the sky. If you then turn to face east, roll the map around so that east is at the bottom, to compare the stars on the map (lower half) to those in the eastern sky. Because it is best used this way, the "Sky Reporter" star map is sometimes called a "roll-around" map.

The maps are prepared for 9:00 P.M. during the early part of the month, but they also apply correctly at earlier times later in the month. The correct time for which the map applies on any date may be found from the appropriate line in the celestial events chart for the month.

THE CELESTIAL EVENTS CHART

The specially designed celestial events chart allows you to locate the moon and the bright planets with respect to the rising or setting sun. It shows you the times of sunrise, sunset, and twilight, the rising or setting times of the moon and the bright planets, and the amount by which the apparent sun is slow or fast on mean time (also the sundial correction).

The locations of the sun, moon, and the bright planets are continually changing within the narrow belt of the sky known as the zodiac. The narrow strip at the top of the celestial events chart shows where the planets are located on either side of the sun on the 15th of the month, and the dates and locations (with respect to the sun) of significant phases of the moon. The hours corresponding to the positions of these objects on the chart are the times when they will be on the observer's meridian (in the sky due south, at their highest positions). The positions of these objects to the left or right of the sun shows whether they will be in the evening or morning sky, and approximately how long after or before the sun they will set or rise. For example, the first-quarter moon is shown at the 6:00 P.M. position, to the left of the sun. This indicates that it will reach the meridian (being then in the southern sky) at 6:00 P.M., and that it will be an evening object, setting about six hours after the sun.

The lower portion of the celestial events chart is a graph that indicates, by shading, the hours of night, twilight, and day. The dotted and dashed lines, each appropriately labeled, show the time during the month of the events identified—sunrise, sunset, and twilight, the rising or setting of certain planets, and the time during the month for which the monthly star map is most accurate. The times of these events may be found from the scale at the bottom of the graph corresponding to the date at the left- or right-hand margins.

The vertical curve (formed by sun symbols) near the noon line on the graph indicates when the apparent sun is slow (to the left of noon) or fast (to the right of noon) on mean time. The correction to the sundial may be found by using the scale at the center of the graph to determine how fast or slow the apparent sun is on any date during the month.

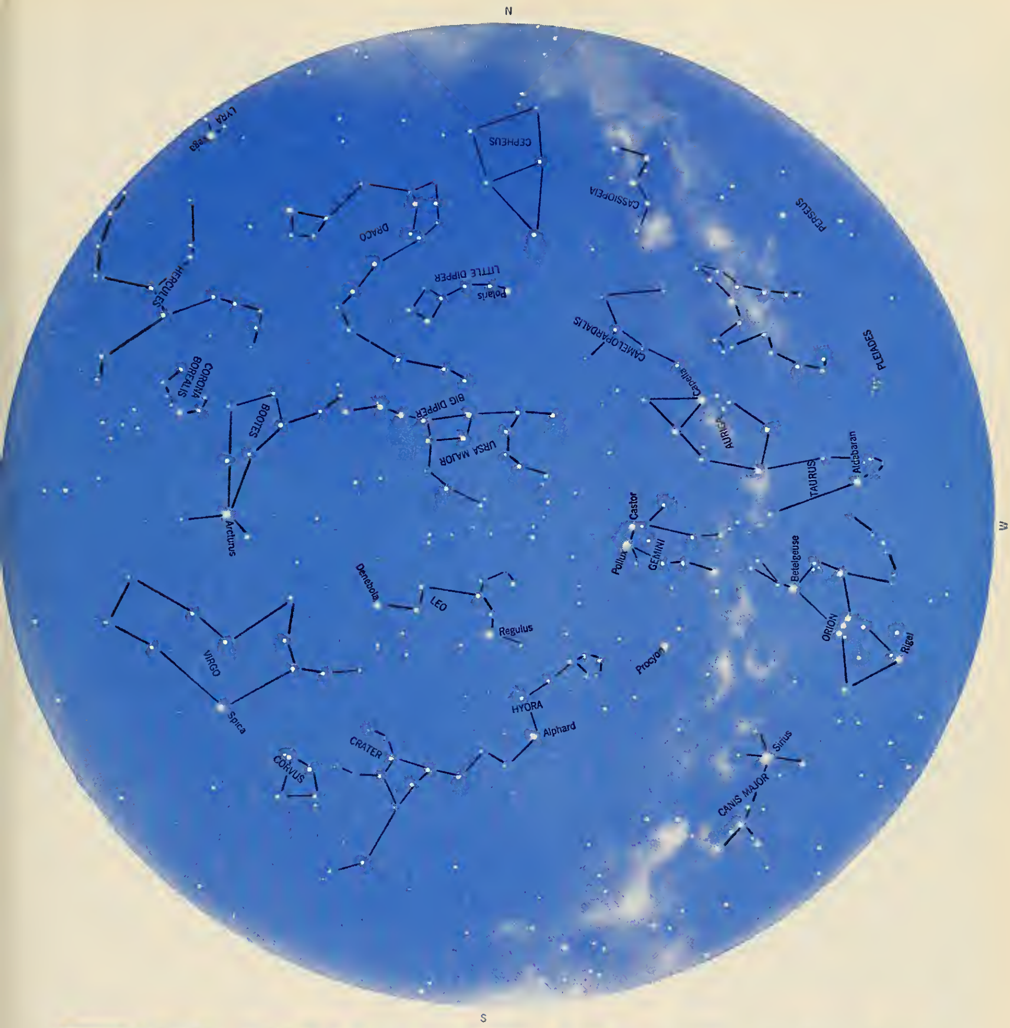
THE SKY IN APRIL

Venus (magnitude −3.5) is the brilliant planet seen in the west from early twilight until after dark. The crescent moon is near the planet on the evening of the 13th. Mars (magnitude −1.3) is at opposition on the 15th, and is nearest to earth on the 21st, about 55,850,000 miles away. It is visible all night among the stars of Virgo, rising in the east about sunset, setting in the west about the time of sunrise. Jupiter (magnitude −1.7) becomes visible high in the south at dusk, just to the right of the stars of Leo, and sets in the west shortly after midnight.

The Lyrid meteor shower reaches maximum during the morning of April 22, but meteors from the shower may be observed during the early morning hours for several days before and after that date. The single observer hourly rate is about 15. The radiant is near the bright star Vega, which will rise in the northeast about 9:00 in the evening.

There will be a total lunar eclipse during the morning hours of April 24, the date of the full moon. The eclipse will be visible, at least in part, throughout most of North America, but the moon will set along the east coast before the umbral phase begins. Farther west, however, where the moon remains above the horizon longer, the beginning partial phase of the eclipse and the total phase will be visible.

Thomas D. Nicholson


N
LYRA
Vega
CEPHEUS
CASSIOPEIA
PERSEUS
DRACO
HERCULES
LITTLE DIPPER
Polaris
CAMELOPARDALIS
PLEIADES
CORONA BOREALIS
BOOTES
BIG DIPPER
Capella
AURIGA
Aldebaran
TAURUS
URSA MAJOR
Castor
Pollux
GEMINI
Arcturus
Betelgeuse
W
Denebola
LEO
Regulus
ORION
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Procyon
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Spica
CRATER
CORVUS
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CANIS MAJOR
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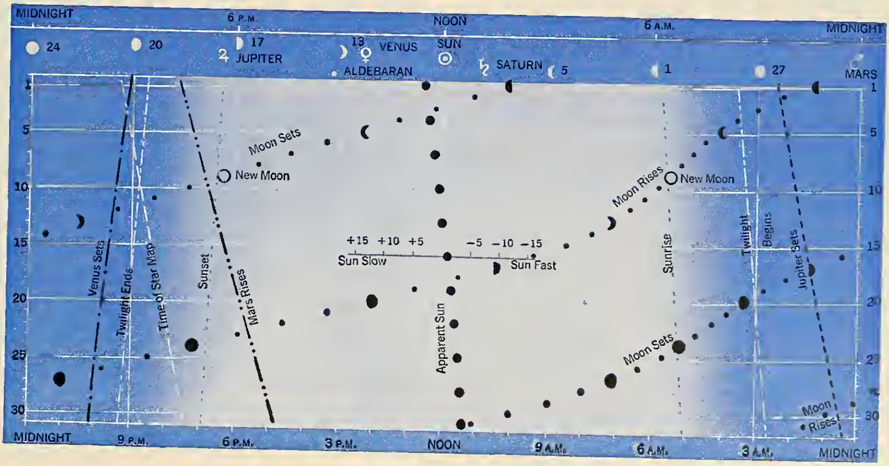
MIDNIGHT
6 P.M.
NOON
6 A.M.
MIDNIGHT
24
20
17
JUPITER
13
VENUS
SUN
ALDEBARAN
SATURN
5
1
27
MARS
1
5
10
15
20
25
30
Moon Sets
New Moon
Moon Rises
New Moon
+15 +10 +5
−5 −10 −15
Sun Slow
Sun Fast
Venus Sets
Twilight Ends
Time of Star Map
Sunset
Mars Rises
Apparent Sun
Moon Sets
Sunrise
Twilight Begins
Jupiter Sets
Moon Rises
MIDNIGHT
9 P.M.
6 P.M.
3 P.M.
NOON
9 A.M.
6 A.M.
3 A.M.
MIDNIGHT

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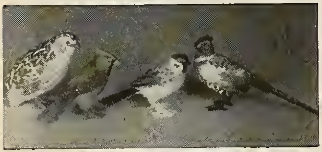

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Last Days of the Onitsl

by Robert E. Morsberger

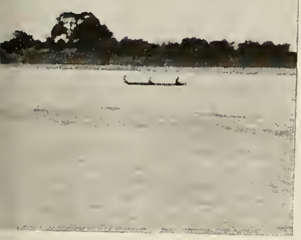
The Niger, third longest river in Africa (about 2,600 miles) has been more a barrier than an aid to transportation. Although seagoing vessels have worked their way up it as far as the confluence with the Benue and then up the Benue to Makurdi in northern Nigeria, most large ships dock at Port Harcourt to the east and do not penetrate the maze of waterways that make up the Niger Delta. The Niger so fragments and loses itself in the delta that for centuries it was unique in that its mouth, rather than its source, eluded discovery. Today traffic up and down the river consists mostly of fishing craft, long log canoes, and passenger transports propelled by oar or outboard motor.

Most of the traffic in Nigeria goes by road from Lagos and Ibadan in the southwest either to Kaduna and other cities in the north or to the relatively prosperous and densely populated Eastern Region, with its major cities of Port Harcourt, Calabar, Aba, Enugu, and Onitsha. Until the opening of the bridge at Onitsha in January, 1966, the Niger was the major obstacle to east-west traffic. No railroads or bridges crossed it until several hundred miles to the north, where the river bends far to the northwest and cuts across the Ibadan-Kaduna highway at Jebba. (That bridge is one lane, and a bridge across the Benue at Makurdi also has a solitary lane, which is used in turn by the railway, droves of humpbacked Fulani cattle going south, pedestrians, cyclists, and all automotive traffic.) The only place where vehicles could cross the Niger from west to east was at the ferry between Asaba and Onitsha, the major river town (population 80,000), which claims to have the largest market in tropical Africa.

Both goods and passengers trave
mainly by lorries, known throughou
West Africa as "mammy wagons.'
These are mostly Mercedes-Benz o
Morris trucks with wooden superstructures built locally and decorated wit
flashing eyes, flaming suns, and othe
dramatic designs. Across the front ove
the cab the vehicle's name is painte
in large letters: The Senior Tarzar
Son of Whether, The Mark of Zorr
No Condition Is Permanent, Salutatio
Is Not Love, Fear Women, Senio
Lover, True Sweat, Thruth [*sic*]]
Money, Why Worry, Hosanna Simb
Simbo, Jesus the Light of Nations, Th
Senior Glory Be to God, and Why N
Fargo; or Igbo names such as *Chuku*
Di (God Exists) and *Ife Sina Chi* (
Originated from God). The drivers a
a tough and resourceful breed. The
have to be. Most Nigerian roads ha
only one paved lane, if any, and veh
cles passing each other must swer
halfway off the tarmac (with t
shoulder often eroded six inches
more below road level) and boun
along, half in the bush, until they c
pull back on the paving. Except in t
cities, petrol stations and resthous
are few and far between.

Many of the lorries are in such be
up condition that traveling in them h
the appeal of Russian roulette. Wh
the transmission fails, the differenti
drops out, an axle breaks, or so
other calamity occurs, the drivers i
provise repairs on the spot. Branch
or palm fronds spaced along one h
of the paving warn other motorists t
there is a broken-down vehicle ahe
It is hazardous to follow too closely
hind a lorry grinding and belching
a steep hill, for many have fau
brakes; and if they cannot make
climb, they slide back down unl

erry



some of the crew can leap out in time and place blocks of wood under the wheels to halt the descent.

The lorries are heavily laden either vith goods or with as many as fifty pas- engers, packed in as tightly as live argo was on slave ships, or dangling ver the tailgates. Lorries may take all ransport material, all human cargo, r a mixture of both. Their main com- etition is from the ubiquitous taxis, nostly Peugeot 7-passenger wagons, ninibuses, or diminutive Morris Min- rs. Both lorries and taxis act as buses, king travelers anywhere from five to ve hundred miles.

The Long Wait

All of these vehicles, plus private ırs, had to cross the Niger by the saba–Onitsha ferry. The ferry serv- e was as old as automotive transpor- tion in that part of Nigeria—about vo generations—and with the expan- on of traffic in recent years, the ferry as increasingly unable to handle the ad. On the eastern, Onitsha side, the ait was comparatively short because e traffic dispersed, much of it mak- g a circle tour to Jos and Zaria in the rth and back to Ibadan by the west- n highway.

However, the pileup was incredible the western Asaba side, where all traffic from Lagos, Ibadan, Ife, and nin waited to cross the river to the stern Region. There were usually m sixty to more than a hundred lor- s lined up along the narrow, pot- led road leading to the landing, and en one could have flown to Nigeria m New York or London in less time n it took to cross on the ferry.

n the dry, "harmattan," season, this roach is choked with red laterite t; during the rains, it is a treacher-

THE QUESTAR TELESCOPE IS A VALUABLE TEACHING TOOL

It is indeed gratifying that every month more and more elementary schools, high schools, and colleges are buying Questars. Many educators have realized that it isn't always necessary to spend hard-won tax dollars to build an observatory with a large, expensive telescope in order to provide an astronomy course. If you have $10,000 to spend, for example, 10 Questars would furnish a whole class in astronomy or general science with superfine telescopes, with the added advantage of being able to use them in the daytime for safe solar work and nature study. Moreover, today's fine plate-glass windows permit flawless views of the heavens, except near the zenith and for this a skylight might be utilized. A south-facing window will permit following of the moon and many other important sky objects.

Recently we received a letter from Mr. Curtis W. Gable, an eighth-grade science teacher who decided to experiment with his own Questar in his classroom. He used it for teaching the types of astronomical instruments and for studying the sun with Questar's safe, external solar filter.

The students responded with such delight and exuberance that a regular program involving other science teachers and approximately 200 students was developed. The course helped to identify several students who proved to be capable of high-quality work in astronomy.

This student interest led next to the forming of an astronomy club which met several times a month. Its wide range of activities included a discussion of current events in astronomy, a presentation of special reports on astronomical subjects, the showing of 35-mm. slides, practice in the use of the telescope, and special observation sessions. While club members brought in their own telescopes, the Questar, because of its being so easily set up as an equatorial, and because of its clock drive and setting circles, was the most useful for teaching.

We were particularly interested in the instruction course each student was put through before he was permitted to use the instrument. First he was given some typed pages of information to read, which included a numbered diagram of the Questar and a correspondingly numbered list naming and describing the parts of the telescope. Another page explained the optical system, comparing it with conventional telescopes. There were directions for locating a celestial object, and, finally, a list of club rules.

Group instruction in the handling of the Questar was followed by the individual guidance of each member. He was given several "dry runs" in its use and was permitted to touch only the control knobs. Great emphasis was put upon keeping fingers off the optical surfaces. The safety factor of the sun filter was particularly stressed, and any violation of the safety rules resulted in dismissal of the club member. Teaching was thorough, leaving nothing to chance. Each club member had to demonstrate that he had mastered the technical information and had skill in its use.

Mr. Gable says the results were well worth the precautions; that with proper instruction, and strict discipline on the part of the owner or teacher, groups of children can use the Questar without damage to it or themselves.

Actually, Questar is a rugged little giant of a telescope, so well built that it can stand considerable abuse. Some have been out in the schools now for nearly ten years, and occasionally one comes back for cleaning and inspection. We seldom find anything seriously wrong. Even one or two that had been dropped sustained only minor damage. The drives will show wear, just like the brakes on your car, in proportion to their hours of use, but this is a simple replacement for which our charge is five dollars for each drive. Furthermore, we have a special low-rate service charge for all educational institutions, which the schools have found most reasonable.

Indoor Comfort With Questar

Time was when trying to see through a windowpane with a fine telescope would have been out of the question. But today's plate glass is so remarkably plane parallel that anyone can have an observing corner like this. The glass happens to be the double insulation type, yet no distortion of image occurs at high power, and the light loss is so negligible that we can still see the companion of Polaris with a Questar.

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handful of people like Mary Carnwath re trying to keep our promise to the Indians. But they won't make it without you.

The Hopi Indians' village of paulovi in Arizona sits on land poor, infertile and inhospitable t so far nobody has tried to take way from them.

Electricity has not yet reached Hopis. Water must be hauled m three miles away. Jobs are few d far away. Only poverty and des- r are close-by and in abundance.

Yet for the first time in genera- ns, Mary Carnwath and people e her are stirring hope among the pis.

Mary Carnwath works and es two thousand miles away, in anhattan. Her own daughter is w grown-up, and through *Save Children Federation* she is spon- ring one of the village girls, 8-year- l Grace Mahtewa.

The Mahtewas (two parents, ree children, one grandmother d a sister-in-law) live tightly cked in a tiny rock and mud use. The father who knows ranch rk but can't find any most of the ar, isn't able to provide the family th even the bare necessities.

Grace, bright, ambitious and industrious, would possibly have had to quit school as soon as she was old enough to do a day's work. But, because of Mary arnwath, that won't be necessary.

The $12.50 a month contrib- ed by Mary Carnwath is provid- g a remarkable number of things r Grace and her family.

Grace will have a chance to con- nue schooling. The family has en able to make its home a little ore livable. And with the money ft over, together with funds from her sponsors, the village has been ole to renovate a dilapidated build- g for use as a village center. The nter now has two manual sewing achines that are the beginnings of small income-producing business. 's only a small beginning. More oney and more people like Mary arnwath are needed. With your elp, perhaps this village program

will produce enough money to end the Hopi's need for help. That is what Save the Children is all about.

Although contributions are deductible, it's not a charity. The aim is not merely to buy one child a few hot meals, a warm coat and a new pair of shoes. Instead, your contribution is used to give the child, the family and the village a little boost that may be all they need to start helping themselves.

Sponsors are desperately needed for other American Indian children —who suffer the highest disease rate and who look forward to the shortest life span of any American group.

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Mary Carnwath knows that she can't save the world for $12.50 a month. Only a small corner of it. But, maybe that is the way to save the world. If there are enough M Carnwaths. How about you?

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is morass. The lorries were forced to ait in line (indeed, they were so mmed together there was no choice), it automobiles could usually crawl ist and get priority service, although was always advisable to wire for resvations to the Asaba Inland Waterays office at least a day in advance. ith luck, a car might cross in two or ree hours, but lorries usually waited to two days and sometimes as long two weeks. On some memorable ocsions when ferries broke down, no iffic could move at all, and not even rs could get through.

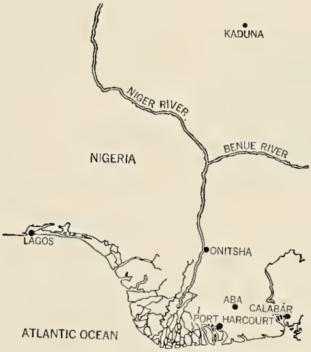
There were two ferry boats, operated the Onitsha Inland Waterways and Asaba Inland Waterways. The arge was sixpence per person, one and per car, and one pound ten shilgs for lorries. The ferries started opting at 5:30 A.M. and stopped at 0 P.M. The river here is about a e wide at high water, but the ferry te was longer because Asaba is gonally across—slightly upriver—m Onitsha. Each round-trip cross, including loading and unloading, ally took about an hour, although n the current was particularly ng, it carried boats rapidly over to tsha, whereas the return ferry ht take a full hour struggling inst the current. The larger craft ld accommodate fifteen or sixteen cles (depending on size and line, usually including four or five lor- and the rest automobiles. The ller ferry usually took two lorries eight or nine cars, so the maximum ber of vehicles that could cross in y, if both boats were working, was it 100 lorries and 250 cars.

Hazards of Delay

it usually one of the boats was en down, and occasionally both laid up for repairs. Then the sitn became unbelievable. Several red vehicles of one kind or an might be piled up at Asaba for or even weeks, and the end of the grew as fast or faster than the moved forward. There is only catering resthouse, small and of quality. The other "hotels" are better than shanties. Even when nmodations were available, most rs dared not leave their vehicles se, as one said, "There be many s who steal everything. If you car, rogues steal tires, maybe engine parts." Thus, drivers d together at night to take turns ng watch of four or five hours while the others slept in their ve. One driver commented: "But bad. Many, many mosquitos by Mosquito very harmful one—eat ll over so he get malaria." The facilities at Asaba are inadequate—most of the drivers bought food from vendors—and the sanitary facilities are even worse. Although drivers were usually braced for a two-day wait, a prolonged delay was an ordeal for even the most hardened.

When the jam was so great that not even passenger cars could move, those travelers with chauffeurs bailed out, crossed the Niger by passenger boat, and took a taxi from Onitsha to their destination, leaving the drivers to bring the vehicles on in due time. Once, "due time" for a stranded driver was two weeks.

Pileups and delays were caused by factors other than malfunctioning ferries. If a group of important politicians drove from the west to the east for a campaign or a major palaver, all other traffic had to pull aside and wait for them. And once when former President Azikiwe (better known as "Zik") was taking a pleasure cruise up and down the Niger, all boating across the river had to stop.



Even when the traffic was moving, the crossing was a bit of an adventure. Lorries and cars jockeyed into position on the steep landing, trying to edge each other out and get aboard first, and there was a deafening clamor of "Close up, driver! Don't let that taxi cut in front of you." "What does that idiot think he's doing?" "Get back in line, you imbecile!" Collisions were narrowly avoided, but scraped fenders were routine.

On Sales Resistance

All the time you waited on the landing, you were harassed by swarms of vendors hawking an incredible variety of cheap wares. They practically climbed in the window, urging in voices charged with dramatic tension, "See, master, these lovely limes. Here, you take for only two shillings." "Master, quick, tell me which one of these pens you will buy. Neither? But mas-

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ter, master, you must buy one of them, cheap, cheap, you tell me which." "Master, I sell you this combination comb and mirror special cheap, just for you, my customer. No? You take this toothbrush, then." And the brush was waved under your nose. "No teeth," you might mumble in defense.

Dozens of booksellers thrust at you an assortment of dictionaries, physics textbooks, Edgar Wallace paperbacks, and Onitsha pamphlets—lurid potboilers with incredible typesetting and startling titles, including *Sweet Mabel, Every Man's Pot of Honey; My Seven Daughters Are After Young Boys; How a Passenger Collector Posed and Got a Lady Teacher in Love*; cautionary tracts (*Beware of Harlots and Many Friends*); and self-help booklets on everything from how to write business letters to how to have a successful marriage. And in a tense whisper, as if he were selling atomic secrets, a boy announced to me, "Look, master, the latest James Bond book. By Ian Fleming. The last book he write before he die," brandishing not a Bond at all but Fleming's *Thrilling Cities*. "Customer, you buy cigarettes—State Express, Galleons, Three Ring, you tell me which." ("I don't smoke," I once muttered, "gives you lung cancer." "Oh no, master, evidence is not conclusive," was the quick response.) Rejecting kewpie dolls, plantains, heads, groundnuts, hardware, goat meat shish kebab, and other tempting wares, you finally drove aboard the ferry, only to be surrounded by more vendors on deck.

Sometimes the last vehicle aboard had to back off again to lighten the load enough for the ferry to pull loose

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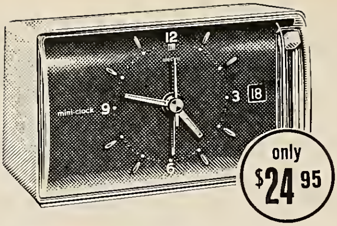

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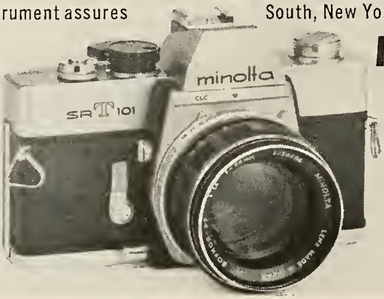


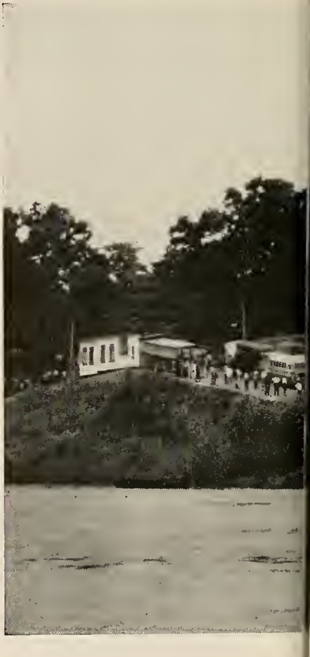
from the bank. Then the vehicle plunged through the water. across the widening gap, and up the trailing gangway, which was then winched up.

There could be problems even after the crossing began. One boat was so overloaded that it lost a lorry overboard in water so deep it could not be recovered. On another occasion, one ferry was out of operation and the other was functioning on only a single engine, which died in midstream. The boat was adrift in the current for five hours and was kept off sandbanks only by small craft swarming around to push it away.

As you disembarked at Onitsha, the traffic was much lighter—usually backed up no more than a block—and lined up along the steep descent next to the river wall. Taxi drivers backed up to the wharf to collect passengers for Onitsha, Enugu, and Aba. As each vehicle came aboard the ferry for the return run to Asaba, boys sang out, "Driver OK—oh!"

End of an Era

But for the last three years the ferry's days have been numbered, and its service has deteriorated accordingly. A developing nation like Nigeria cannot afford to have such a bottleneck on a major transport route, and so its six-year development plan included a bridge to span the Niger at Onitsha. This is a steel truss bridge, 1,100 me-



ters long, its twelve spans supported by concrete piers. It is long and low, and gleams with aluminum paint. The road deck is inside, rather than on top, and there are three lanes, so that traffic on the center one can be switched as needed during the rush hours. Construction took three years and cost six and a half million pounds.

Toll for the bridge is less for cars but slightly more for lorries than on the old ferry; consequently there have been complaints. One African newspaper correspondent felt there should be a toll for cattle, which were, he claimed, dropping enough dung on the bridge to cover the entire Sahara: "To share the bridge with them, in my opinoin [*sic*] is highly suicidal. Besides, during the rains, the cattle dungs [*sic*] could cause a lot of havoc to the bridge users." But on the whole, the regular drivers emphatically agreed with William Anozie's statement in *The Daily Times*: "The opening of the Niger Bridge is of immense advantage to drivers and other regular users of the route. Sometimes at Asaba, we are ttacked, but this will not happen gain now that we do not have to wait here any longer." Anozie, who drove taxi for six years between Lagos and nitsha, claimed the damage to vehicles on the ferry was "appalling," ut "thanks to God we shall not experience such again."

Naturally, the ferry operators were disgruntled. Vendors can always find another place to operate, but the Calabar ferry at the Cross River is run efficiently by the Elder Dempster Company and has no use for the dilapidated Onitsha boats. Probably they will be moved up the Niger to Idah, where there has been no service at all. With the new bridge, transportation is immensely improved, but a colorful part of Nigerian history has come to a close.

POSTSCRIPT: Since the second military coup in July, 1966, and the Hausa pogrom against Ibos, the Niger Bridge has taken on strategic importance as the only road across the river into the Eastern Region. The bridge continues to function normally except for a roadblock on each side, where police and soldiers stop all vehicles and search them for weapons and ammunition. The coup has resulted in a widespread repatriation of Nigerians to their regions of origin. Transporters are making huge profits from refugees, primarily Ibos returning to their homeland and others migrating back to their own villages for security, and fares have become greatly inflated. Nevertheless, the bridge has alleviated the delays, congestion, and hardships that so often accompanied river crossings in the days before January, 1966.

"With luck, a car might cross in two or three hours, but lorries usually waited up to two days and sometimes as long as two weeks."

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A Puerto Rican Family

By Joseph Monserrat

La Vida, by Oscar Lewis. *Random House, $10.00; 669 pp.*

The lives of sixteen Puerto Rican slum dwellers, the Ríos family, are the subject of anthropologist Oscar Lewis' latest book, *La Vida,* subtitled *A Puerto Rican Family in the Culture of Poverty—San Juan and New York.* The book actually consists of two parts. One is the tape-recorded narrative that comprises the body of the volume. The other is the introduction, which contains the author's description of his theory and method.

Any serious discussion of this book requires that its two parts be studied separately. The narrative, collected on tape and edited by Dr. Lewis, is a powerful portrayal of the loves, hopes, fears, and desires, the aspirations and driving emotions of this single Puerto Rican family. Few, if any, of the overt details of this family's life are missed. Nothing is left to the imagination. Their weaknesses, as well as their strength, are demonstrated. The extreme and uninhibited articulateness of this family is somewhat surprising but not accidental. For, as Dr. Lewis states, "The principal criteria in the selection of families were low incomes, relatives in New York, and a willingness to cooperate in the study." One presumes he means a willingness to talk into his microphone about things that most families, poor or rich, do not so readily talk about; certainly not in such vivid and uninhibited detail.

The recorded and edited autobiographical stories of the Ríos family read like a novel, more so than the author's best-known previous works, *Five Families, The Children of Sánchez,* and *Pedro Martínez.* The first chapter, which establishes the setting in La Esmeralda, the San Juan slum the Ríos family lives in, is in fact a fictionalized description both of the slum and the "main characters" of the book. As a novel, *La Vida* has all the necessary ingredients that constitute a best seller: sex, prostitution, and violence. It is a "hot" book.

La Vida, however, is not a novel. It purports to be a work of science—an anthropological study of a Puerto Rican family in the culture of poverty. For this aspect of the book one must turn to the introduction. Here, any careful reader finds himself in a quagmire. Dr. Lewis is most difficult to pin down. To grasp his words is to touch quicksilver. His theory is pegged to the assumption that "The intensive study of life of even a single extended family by the methods used in this volume tell us *something* [my italics] about individuals, about family life, about lower-class life . . . and about the history and culture of the larger society in which these people live."

Granted it tells us *something.* But what? He states that he has "tried to give voice to people who are rarely heard, and to provide the reader with an inside view of a style of life which is common in many of the deprived and marginal groups in society. . . ." and then proceeds to caution, "I should like to emphasize that this study deals with only one segment of the Puerto Rican population and the data should not be generalized to Puerto Rican society as a whole"! This contradiction, that the style of life he presents is common but should not be generalized, becomes even more absurd when later in the introduction he states, "I am suggesting the possibility that studies of the lower class may also reveal something that is distinctive of a people as a whole." It's that certain *something* again.

Dr. Lewis says, "the Ríos family i not presented here as typical . . . bu rather as representative of one style o life . . . the frequency distribution o this style of life cannot be determined until we have many comparable studie of life in a Puerto Rican slum." How true, except that earlier in the intro duction Dr. Lewis had told us, "Th people in this book, like most othe

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Puerto Rican slum dwellers I have studied, show great zest for life, especially for sex, and a need for excitement, new experiences and adventures." First he can't determine the frequency distribution, then he determines it with the subtle phrase "like most other Puerto Rican slum dwellers I have studied. . . ."

Dr. Lewis tells us that it was his "dissatisfaction with the high level of abstraction inherent in the concept of culture patterns" that led him to "turn away from anthropological community studies to the intensive study of families." For he says, "In describing total culture patterns there is an almost inevitable neglect of the range of variation in custom and in behavior which may lead all too readily to overdrawn configurations that play up differences between cultures and tend to ignore the fundamental human similarities." In other words, traditional anthropology is guilty of going from the abstract general to the concrete specific. I am suggesting that throughout his introduction, Dr. Lewis is guilty of going from the concrete specific to the abstract general, and doing it in such a way that it is difficult to determine where the starting and finishing points of his generalizations are.

For instance, no mention is made of exactly how typical the Ríos' are of Puerto Rican slum dwellers (except in such generalized statements as, "like most Puerto Rican slum dwellers I have studied"), nor of how typical slum dwellers are of Puerto Ricans, nor how typical is this slum (where, he states, about one-third of the women have a history of prostitution) of other slums. Unless he knows something he is not telling us, and this implication abounds throughout his introduction, Dr. Lewis must face up to the charge that his method appears shoddy, unscientific—even "unsocial-scientific."

Dr. Lewis asserts that he is aware that his study "runs the risk of offending some Puerto Ricans. . . ." He says that he is also aware that his findings may be misinterpreted or used to justify prejudice. Yet far from carefully assuring that misinterpretation does not result, he has outfitted his volume with a title that is sensational, *La Vida*, originally entitled *En La Vida* by the author. This title is derived from the Spanish euphemism for a prostitute, *una mujer de la vida*, "a woman 'in the life.'" It appears to this reviewer that a social scientist who writes a book that purports to be an anthropological study intended to tell us *something* about the culture of poverty should not use a title that cloaks a sordid innuendo, intentional or otherwise. Unless, of course, the culture of poverty is a study of prostitution among the poor. Dr. Lewis does not claim this.

Both in the introduction and in correspondence with this reviewer, Dr Lewis states that the culture of povert (which he says should be more accurately called the subculture of poverty) is found among multiproblem families "My own work," he wrote this reviewer, "has been focused on a specia segment of the Puerto Rican population—namely, the people designated i social work as 'multiproblem families. Indeed, the subject of my first boo [of a series about Puerto Rico] 'Th Ríos Family' . . . was one of sample of 225 low income multiproblem families carefully selected at considerable cost. . . ." Since it is obvious then, that the study of the culture o poverty is not a study of prostitution one can only conclude that the autho recognized such a title might sell mor books.

Dr. Lewis has been pioneering wit new approaches for anthropologica studies that no doubt will make a valuable contribution to this and possibl other fields. But, as he states, "Th absence of intensive anthropologica studies of poor families from a wid variety of national and cultural co text . . . is a serious handicap in formulating valid cross-cultural regular ties. The model presented here therefore provisional and subject t modification as new studies becom available."

The author recognizes that the mod of his concept of the culture of pover as presented in *La Vida* is "provision and subject to modification," meanir therefore that it is incomplete and i conclusive. He further recognizes th this study can hurt thousands of Puer Ricans since he is aware that his "fin ings" may be misinterpreted or us to justify prejudice. From these tw concepts it must appear that Dr. Lew is guilty of professional and social responsibility.

Joseph Monserrat is the Director the Migration Division, Department Labor, Commonwealth of Puerto Ri

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HERCULANEUM, by Joseph Jay Dei *Thomas Y. Crowell Company, $6.9 174 pp., illus.*

IN this attractive volume, Joseph J Deiss, American writer on Itali subjects, tells the story of Hercu neum, one of the sites destroyed by t eruption of Vesuvius in A.D. 79. T author first became attracted to t city while in Italy, gathering mater for *The Great Infidel*, a book on Hohenstaufen emperor Frederick Although the author draws freely other books about Herculaneum,

thoroughly acquainted himself
the excavations and writes about
with feeling.
e book opens with a description of
ife that was so suddenly snuffed
'hen Vesuvius submerged the town
r sixty feet of volcanic mud,
ı, upon cooling, sealed the town
preserved all its contents. Most
ɜ inhabitants, however, were able
;ape. Nearby Pompeii, which was
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te only a few of the public build-
ıave been found. Clumsy robbery
e eighteenth century destroyed
nly theater from antiquity that
have come down to us intact. The
ca was also an early discovery,
ɔme of the finest painting in the
ı Nazionale in Naples comes from
ılls. More recently, two baths,
ıf the sports palaestra, the en-
to the forum, and the headquar-
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d. It is the homes, however, with
ıre and personal possessions per-
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;limpse of the life of these peo-
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know them as well as we know
ıeighbors at Pompeii. For the
phical evidence at Herculaneum
slight compared to the thou-
ıf inscriptions found at Pompeii,
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and at times even give their
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ıneum and laments that so little
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. Those who have seen how
e to the air and elements has
l in the deterioration of the
Pompeii would prefer, how-
ıat available funds were ex-
first to preserve the priceless
already uncovered.

WILHELMINA F. JASHEMSKI
University of Maryland

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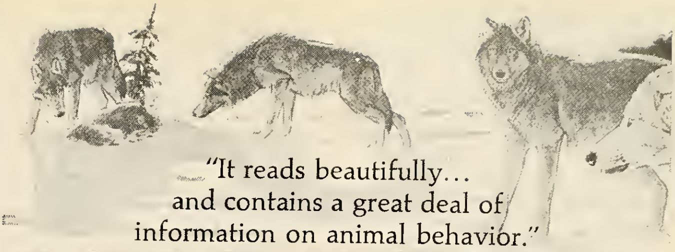
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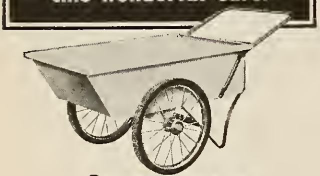

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beyond this: here is personal involvement as well as skillful reporting. He journeys into our hazy, primitive, southern Appalachian Mountains, whose heavily forested ridges seem, from almost any vantage point, to billow on and on into a mystic infinity, and he explores their recesses and becomes enamored. The result is a volume of real excellence that tells much about the region and its people, and something about the author.

As the title suggests, our concern here is not so much with the natural history and the floral phenomenon that attract and hold the imagination of millions of traveling Americans each year, although these aspects are given accurate treatment within the purpose of the author. Here we are to enjoy the colorful parade of human beings whose lives have been conditioned by what was, until recent years, one of the remotest of our pioneer settlements. Here are the first historical occupants, the Cherokees, brutally routed, dispersed, and swindled in the white man's push for occupation; the early settlers who were willing to forgo comforts for the possession of a proud and stubborn independence; the circuit riders and traders and naturalists and the somewhat eccentric brethren who sought the mountain fastness as a hideaway; the ruthless lumbermen, logging the primeval forest on the basis of cut-and-move; and finally coming up to date with the establishment of the Great Smoky Mountains National Park, nobly preserving what remains—and fortunately there is much—of what the first invaders of this wilderness saw.

There are still many of the old stock living in the coves, fearful of the "revenooers" who would despoil their stills, shy of the stranger but hospitable and of gentle courtesy; there are still many residents whose memories were tapped by Frome for a host of fascinating stories of other days. The "hill people" do not easily open their minds to the visitor. It says much for Frome's art and empathy that he could so draw them out.

Freeman Tilden
Author and Naturalist

The Birds of Colorado, by Alfred M. Bailey and Robert J. Niedrach. *Denver Museum of Natural History, 2 vols., $35.00; 895 pp., illus.*

State bird books have blossomed to so great an extent that now one or more can be sponsored by nearly all the units of our commonwealth. Since mapped boundaries are mostly political rather than physiographic, recent authors have shown a tendency to relate the ornithology of a single state to that of its neighbors. Perhaps the example was set by E. H. Forbush (1925 in a famous book that was frankly e titled *The Birds of Massachusetts an Other New England States*, and th well fulfilled its function.

The product of Doctors Bailey ar Niedrach, which marks a new apog of sumptuousness, follows the san tradition and will serve a large ar of the Rocky Mountains and adjace lowlands. For both authors the volum are a logical conclusion to more th forty years of local field investigatio natural history photography, museu exhibition, and laboratory study. Th have teamed up also in several remot parts of the world, but Colorado home ground and first love, evidence which seems to shine through their te and pictures.

The position and structure of th state and its amplitudes of climate, p cipitation, and plant life provide fo rich avifauna. Four hundred thirty-ni species, plus sixty-four additional su species, have been recorded fr Colorado. The number of species a proximates that of New York St where, however, the total is swelled a long list of oceanic birds.

In wealth and quality of illustrati *The Birds of Colorado* sets a new star ard. The authors themselves are in t forefront of wildlife photographers, l they have called upon thirty-odd their colleagues to offer readers a g lery of four hundred likenesses of bi in the wild environment. The displ notable for all groups, is matchless birds of prey and shore birds. Pho graphs not made by the authors a individually credited. The color pla are likewise memorable, their paint including twenty-one widely kno American and Canadian artists, as w as Peter Scott and D. M. Henry Britain. Four hundred and two spe of birds appear in these plates.

The structure of the text is admira comprehensive. History of bird st in Colorado, geographical distributi migration, orientation, the life zo and their plant-animal associations adequately covered. There is an ele page list of Colorado plants, with record of their lower and upper alt dinal thresholds. Nor is the dire increasing threat of pesticides o looked. The gazetteer and state r are exceedingly helpful, and the w is thoroughly indexed. The bi ography cites 446 authors, and m hundreds of references.

The abundantly annotated list of orado birds comprises the bulk of book. Aside from well-digested c piled matter, this includes a we of fresh and significant contribut worthy of quotation at length. A sa

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Robert Cushman Murphy
The American Museum

Science and Survival, by Barry Commoner. *The Viking Press, $4.50; 150 pp.*

Barry Commoner's *Science and Survival* is an uncommonly interesting, thoughtful, and thought-provoking book. Its purpose is to call attention to the ways in which large-scale technology has been developed and exploited before its consequences have been understood. His examples are first the power failure in the northeastern states in November, 1965, then iodine-131 in the thyroid glands of children in Utah. Thence he proceeds to the more general problems of pollution of air, water, and earth—thus of the whole known biosphere—by carbon dioxide, by detergents, by insecticides, by radioactive fallout. He devotes major attention to the possibility of nuclear war: its risks and its probable effects.

Commoner next examines some possible factors that may have led us to our present untenable position: secrecy, competitive struggles between nations for political prestige, the erosion (as he puts it) of the basic principles of scientific discourse, the breakdown of traditional scientific procedures. The single weakness of the book is the inclusion of a chapter that includes, among such factors, the present molecular style in biology. Meaningful though his discussion of molecular biology may be for the sake of biology itself, and I have much sympathy with Commoner's criticisms of it, it is not yet relatable to problems of society.

For solution, the author can do no more than emphasize the need for an approach that will apply the principle of balancing risk against benefit, estimations of which he sees as proper subjects of scientific analysis. The perception of present and future problems by scientists, and the assumption by scientists of the responsibility of informing citizens as to the problems and their putative solutions, are named as possible alleviative measures. Commoner believes that an attempt by scientists to educate an informed electorate, Margaret Mead's "new social invention," may be the one invention of our technological age that can conserve the environment and preserve life on the earth.

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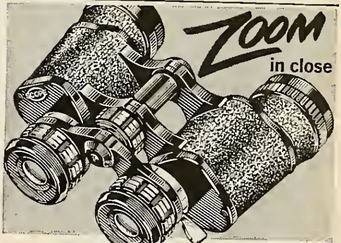

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RED LAND, BLACK LAND, by Barbara Mertz. *Coward-McCann, $6.95; 380 pp., illus.*

IN recent times there has been a tendency for popular books on the ancient world, and particularly on pharaonic Egypt, to be written by journalists, by columnists, by literally everyone under the sun but the specialist. The exception to this statement is Barbara Mertz who has had a very thorough Egyptological training and, indeed, who knows about what she writes. Such a training is desirable since the author can then keep pace with the latest archeological, philological, and historical developments within her discipline and incorporate them in her work. *Red Land, Black Land* is a witty and informative excursion into the world of the ancient Egyptian, a world that all too frequently we moderns tend to consider as esoteric, a world in which pyramids were built, mummies were deposited in tombs, and people wrote in "mysterious" hieroglyphs. This world is touched on in Dr. Mertz's book, for no book on Egypt can help but touch on it, but this is not her main subject or theme. Rather it is the mundane, day-to-day experience of the Egyptians—how they dressed, ate, lived, and thought. An underlying theme, which the author stresses again and again, is the essential humanity of the people of whom she writes, and rightly so. In our present era we tend to forget that, above all, the Egyptians were people who, barring those experiences made possible by technological advances, underwent every conceivable emotion and feeling that we may experience today. The Egyptians laughed and loved, hated, and died, grumbled at taxes, struck when not paid, and went off to war confident of victory, although some, perhaps, had misgivings. They laughed hilariously at a funny story and loved a pun. Their grief at death was as real and as heartrending as ours. This then is the value of *Red Land, Black Land*: it takes the mummies out of the tombs and turns them into what they once were—living, thinking, feeling human beings. Moreover it does so in an entertaining and lively, yet authoritative fashion. One can only highly recommend the book.

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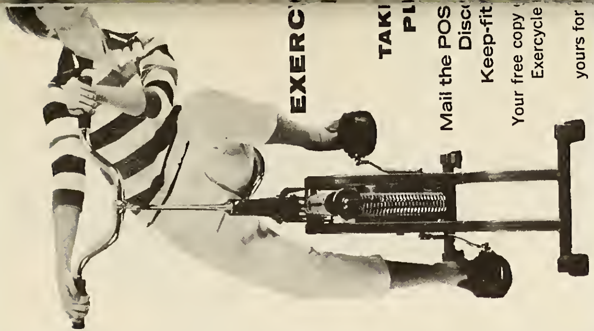
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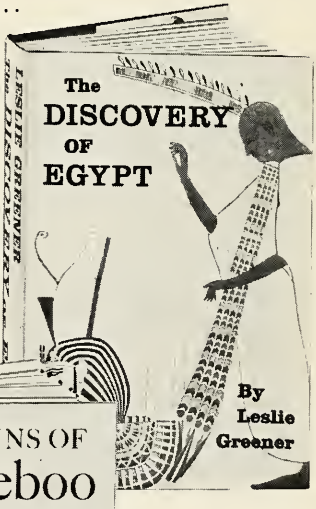
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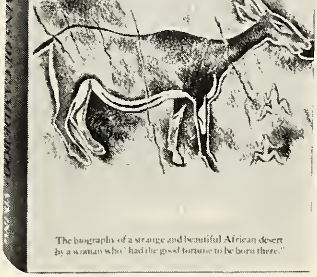
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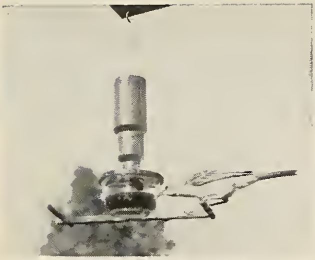

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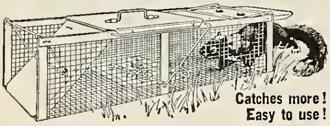
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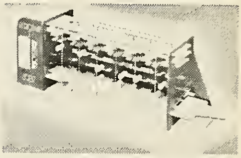

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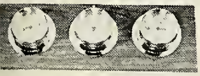

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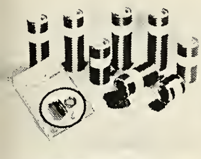

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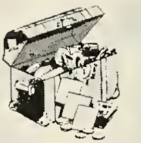

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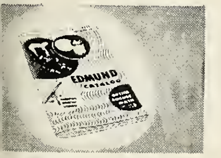

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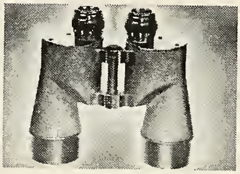

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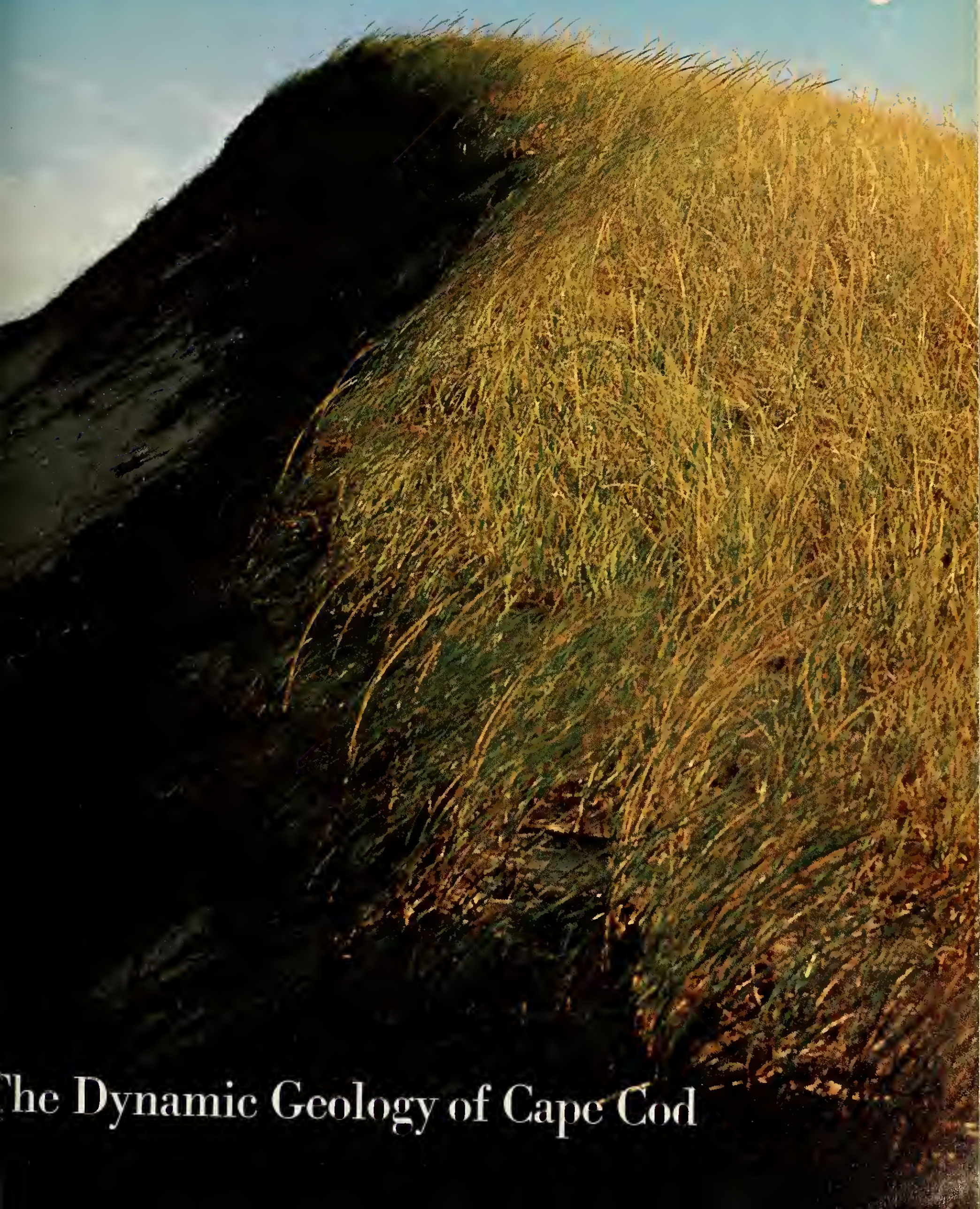

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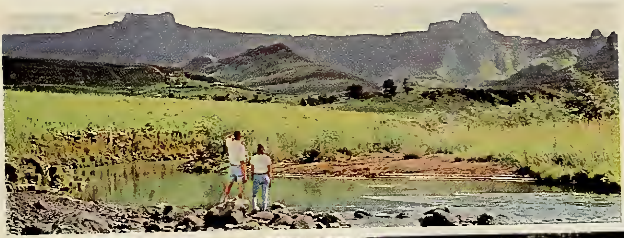

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nts, plus the superb optics of Carl Zeiss lenses with built in Synchro Compur shutters allowing the use of both flash and strobe at all speeds, that the Hasselblad system does.

Here's what the Hasselblad System consists of. Firstly, the 500C, the standard camera in the system[A]. It accepts all seven lenses available for the Hasselblad, and is a single lens reflex viewing camera. The 500C always shows you exactly how your final picture will turn out on the ground glass screen, in the same way a view camera does. This allows you to concentrate on the setting up and composition of your picture, no matter what lens or accessories you are using on the camera.

The lens, magazine, focusing hood and winding knob of the 500C are all instantly interchangeable.

Next is the Hasselblad Super Wide C. The camera that caused a breakthrough in 2¼ square photography. Equipped with a 38mm, 90° angle of view Zeiss Biogon f/4.5 lens, this camera allows you to take pictures previously considered impossible. The superb optics of the lens assures perfect distortion-free horizontal and vertical delineation, with sharpness of image from corner to corner of the negative area, even at full aperture. Depth of field at an aperture of f/22 is from 26 inches to infinity.

The newest camera in the Hasselblad System is the electrically driven Hasselblad 500EL. This camera automatically advances the film and cocks the shutter, allowing a rapid series of exposures to be made, either by use of the camera release or long release cords, timer or remote radio control. The 500EL accepts all the lenses and most accessories available for the 500C. Obviously one of the advantages of this camera is that the photographer is freed from the actual mechanics of picture taking and can therefore, devote himself completely to the subject.

The use of the 500EL with the Hasselblad 70mm film magazine, (up to 70 exposures on cassette loaded 70mm film) allows the photographer, working on a job where a large number of exposures are required, to handle his work load much more quickly and efficiently.

There are seven Carl Zeiss lenses in the Hasselblad System, 40, 50[B], 80, 120, 150, 250[C] and 500mm. Each lens has a built in Synchro Compur shutter, with automatic stopping down at the moment of exposure and manual preview for depth of field checks. Every lens has both M and X synchronization allowing the use of flash and strobe at all speeds up to 1/500th of a second.

Five different instantly inter changeable film magazines are available. These magazines allow the photographer to make 12 or 16 exposures on 120 film[D], 24 exposures on 220 film[E] and 70 exposures on 70mm film. The magazines also allow the choice of 3 formats (2¼ square, 2¼ X 1⅝, 1⅝ X 1⅝) This allows not only for speed of operation, but the convenience of being able to change either film type or format in mid-roll.

Completing the system is a huge range of accessories that includes extension tubes and bellows extensions for close up work, filters, transparency copy holders, cut film backs eye level prism finders[G], sports view finders, sun shades rapid winding crank[I], quick focusing handles[J], grips[K] underwater housings, ring lights tripod quick coupling[L], microscope attachments and carrying cases.

We have purposely avoided discussing specific applications to which the Hasselblad system might be applied. Not only because of the limitations of the space available, but because the number of applications is almost infinite.

Hasselblad systems are being used today in many branches of science and industry. And are even a part of the NASA space program. Shown below are just a few parts of the system that seem to have become particularly popular with many people engaged in some aspect of science or industry.

This description of the Hasselblad system has been necessarily brief. If you would like a Hasselblad catalogue or further literature or if you have a specific technical inquiry write to Paillard Inc., 1900 Lower Rd., Linden, New Jersey 07036.

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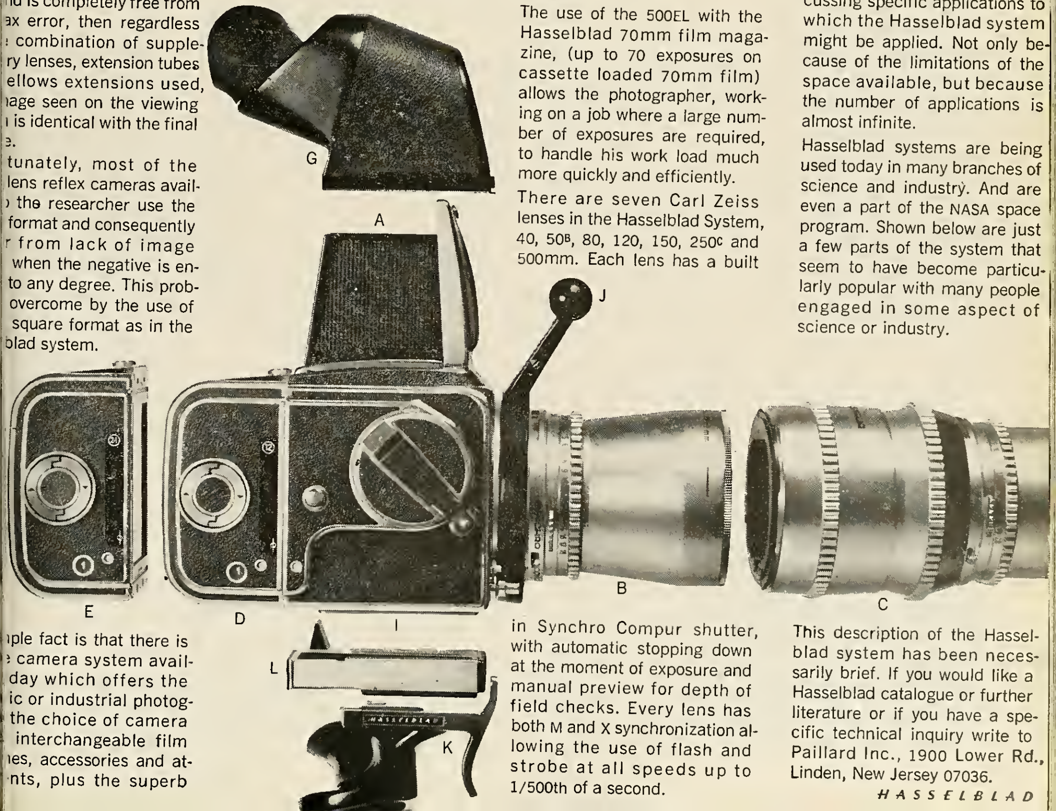

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Vol. LXXVI MAY 1967 No. 5

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COVER: Cape Cod's sand dunes are brand new, geologically speaking. Since th retreating glacier laid down the backbone of the Cape 10,000 years ago, the se and the winds have added daily chapters to its geologic history, tearing away ol lands and building new ones. Barbara Blau Chamberlain writes of these event beginning on page 24. The dune on this month's cover, created by the sea wher the glacial Cape ends at North Truro, is capped by a remarkable beach gras which thrives on a bare sand surface. The grass holds the sand in dunes, whic act as barriers to prevent both sand and surf from rolling destructively inlan

The Dynamic Geology of Cape Cod

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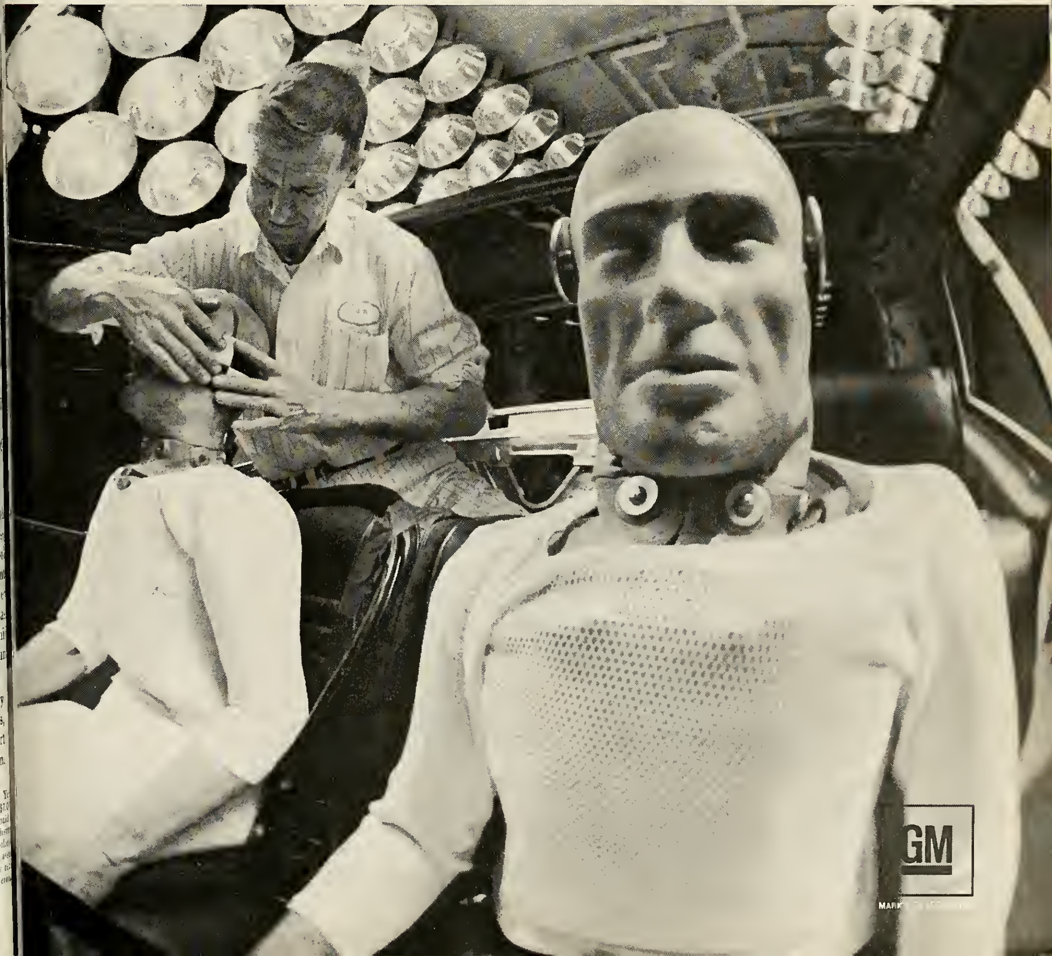
Don Trites, experimental technician, General Motors Proving Ground, Milford, Michigan.



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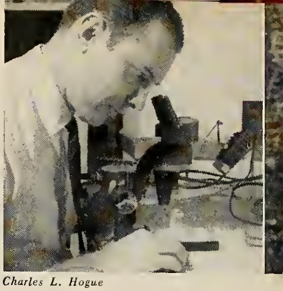

Charles L. Hogue

ABOU

W. Gurnee Dyer

In his current article, "With Net
Hand," CHARLES L. HOGUE depa
from his normally scientific treatm
of entomological subject matter to d
with the habit and history of ins
collecting. Dr. Hogue has occupied
number of research and teach
positions in his field, has authored
score of articles, and is currently
work on a new book, *Insects of the*
Angeles Basin. He is Curator of E
mology at the Los Angeles Cou
Museum of Natural History.

From its salt marshes to its scu
tured cliffs, the Cape Cod Natio
Seashore is well known to BARB
BLAU CHAMBERLAIN. From her tr
ing as a geologist and from her sev
summers spent on the Cape, M
Chamberlain has portrayed the
gion's geology with esthetic sensiti
and scientific scrutiny. Author
These Fragile Outposts, published
the Natural History Press in 1
Mrs. Chamberlain now resides in S
bury, Vermont.

In "The Changing World of
Cree," the lives of this Quebec t
are described by NORMAN A. CHA
director of the McGill-Cree Proj
the photographs are by PAUL CONK
While he heads the five-year stud
developmental change among the C
Dr. Chance also serves as Assoc
Professor of Anthropology at Mc
University in Montreal. He has

bara Blau Chamberlain

Norman A. Chance

Henry L. Ullman

IE AUTHORS

chard E. Orville

William C. Livingston

William Condry

ed research in the southwest ed States, Mexico, Puerto Rico, Alaska. A book by Dr. Chance, *The no of North Alaska*, was issued by Rinehart and Winston in 1966.

. Conklin's photographs have aped in major magazines, newspa- and in several books. For four , he served as staff photographer ne Peace Corps. In addition to his ography, Mr. Conklin has written al articles for various newspapers magazines.

NRY L. ULLMAN maintains an ac- interest in both natural history photography. In order to carry out vations of the smaller animals, Ullman has furnished one room of house with tanks and cages ped with light and temperature ols. "Another 'must' for this sort ocation," says the author, "is an standing wife." A graduate of the ersity of Chicago, Mr. Ullman is employed as a technical writer. rticle on the Hawaiian frog is a er taken from a book that he is preparing on the natural history waii.

several foreign trips, W. GURNEE has taken photographs and has ted data and artifacts for The ican Museum of Natural History, he serves on the Board of Trus- The photographs and information Elephant Work in South India" were gathered by Mr. Dyer in 1966. The author is most familiar with Africa, and a photo collection of African scenes taken by him in 1963-64 is on display in The American Museum.

In this issue, RICHARD E. ORVILLE and WILLIAM C. LIVINGSTON bring their training in atmospheric physics and astronomy to bear on the problem of explaining a common but complicated phenomenon, the rainbow. Dr. Orville has published many technical articles on weather phenomena. He is currently employed as a senior research scientist at the Westinghouse Research Center in Pittsburgh. Dr. Livingston is an astronomer at the Kitt Peak National Observatory in Tucson. He is a specialist in solar magnetism and photoelectric devices, and has authored articles on these topics.

WILLIAM CONDRY obtained degrees in literature and French, and worked as a teacher for several years before turning to writing and lecturing. Mr. Condry has composed broadcast scripts and has written for several magazines and newspapers. He has written a biography of Thoreau, a natural history and topographical study of Snowdonia National Park in Wales, and a study of wildlife in Central Africa. A devotee of nature and conservation, in 1966 he achieved public recognition for his outstanding work in connection with the protection of the Red Kite of Wales.

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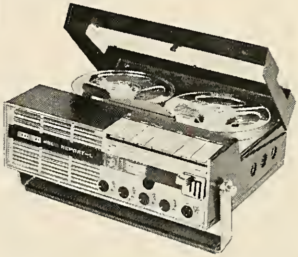

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WITH NET IN HAND

by Charles L. Hogue

Some people exhibit an irresistible urge to acquire and classify things—stamps, coins, buttons, or bottles. But no one has ever explained this curious instinct, and to many people the impulse to collect insects seems the most inexplicable of all man's passions.

In an attempt to explain his pastime, the bug hunter may rationalize that he is making a scientific contribution, that he enjoys the chance to be afield, or that he appreciates the colorful patterns displayed by his specimens. But while these explanations may pertain to the motivation of professional entomologists and some nature lovers, they do not seem to fully describe much of the collecting that takes place.

Indeed, the new collector, in particular, appears to be motivated by what may be called the "pigeon-holing element," which also seems to play a part in the makeup of other types of collectors. This element is characterized by the inherent inability to tolerate gaps and disorder in a system of his own creation. His hunger for orderliness is not satiated until he has personally captured, named, and arranged every recognizable entity within his geographic reach.

Insect collectors, amateur or professional, are happiest at the end of a trip on which they have captured a long-sought rarity, and are most dismal after a long, dry period of inactivity, when they have not had an opportunity to collect or arrange past collections. Dismay is perhaps most intense, and frustration most frequent, when other pressures prevent them from taking to the field to give chase. In any event, collectors know that they like to collect; most retain the desire and practice the habit for a lifetime.

While no single social stratum has a monopoly on collectors, an inordinate number are found among the world's financiers, nobles, doctors, ministers, and statesmen—probably because these people have the time, funds, and education appropriate for such a pursuit. Typical of this group were two members of the illustrious Rothschild family of England. Lord Lionel Walter, first son and successor of Lord Nathaniel, developed the zoological museum at Tring, amassing over two and a half million butterflies, the largest private collection ever made. Walter's brother Nathaniel Charles, a banker by profession, once remarked, "What I would really like is to live in a nice island or settle in Japan or Burmah and be a professional bug-hunter." At first interested in Lepidoptera, he later settled on a lifelong study of fleas and formed a collection of well over 22,000 specimens. The Rothschild collections were eventually

Vladimir Nabokov, the author of Lolita *and a practicing lepidopteri searches a Swiss meadow for butterflies to add to his collecti*

An essay on the habit and history of insect collecting explores some of the fact, and some of the fiction, connected with this unusual avocation

eded to the British Museum—Natu-
l History. (For evidence of the
othschilds' continuing interest in
is area see "Mimicry," by Miriam
othschild, NATURAL HISTORY, Feb-
ary, 1967.)

Other prominent personalities of
e past and present—well known for
complishments other than those in
tomological science—who were
tten by the collecting bug include:
vid Rockefeller of America's fi-
ncially famous family, an ama-
r natural historian, benefactor of
e American Museum of Natural
story in New York, and an enthusi-
ic tiger beetle collector; Alfred
arles Kinsey, authority on human
ual behavior, who started his sci-
ific career as an entomologist and
l wasp collector; Count Pierre
ançois Marie Auguste Dejean,
utenant General and aide-de-camp
Napoleon, who was an indefatig-
e beetle collector and added speci-
ns to his cabinet even during bat-
, including a few from the field of
terloo; Vladimir Nabokov, author
the popular novel *Lolita*, who has
lected butterflies and published ar-
es on their classification. In addi-
n, Neville Chamberlain, former
me Minister of England, and Ser-
Khrushchev, an engineer and son
he ex-Premier, have shown active
rest in butterfly chasing.

he preceding list should make it
r that insect collectors are not all
ks or retarded adults indulging
hild's play as is the practically
versal layman's belief. Neverthe-
, the appearance and dispositions
ome collectors are easily capable
aising eyebrows. W. S. Bristowe,
uthority on spiders, was once ar-
ed in the Louvre for taking a
ll bottle of alcohol out of his
ket to collect a specimen dangling from the brim of his hat, and more recently, a visiting professor of insect physiology at UCLA was catching lawn skippers with a net for laboratory experiments when he was asked by a campus police officer to "move on, please." One verse of a long poem, describing a bug collector of an earlier generation, serves further to illustrate the point:

> Well, true as I live, that old feller
> just spent
> His hull days in loafin' about
> And pickin' up hoppers and
> roaches and flies—
> Not to use for his bait to ketch
> trout,
> But to kill and stick pins in and
> squint at and all.
> He was crazy's a coot, th' ain't no
> doubt.

ANNIE TRUMBULL SLOSSON,
Uncle Jotham's Boarder

For sensitive collectors worried about the impressions they present to onlookers, English entomologists Kirby and Spence long ago (1828) offered the following words of solace:

> With all your implements about you, you will perhaps at first be stared and grinned at by the vulgar; but they will soon become reconciled to you, and regard you no more than your brethren of the angle and of the gun. Things that are unusual are too often esteemed ridiculous; and the philosopher whose object is to collect and study the wonderful works of his CREATOR is often regarded by the ignorant plebian as little short of a mad man.

To the Apache Indians of southern Arizona a man chasing insects with a billowing white net was considered mad and quite harmless. This belief is said to have saved the life of August J. Kusche, an early commercial collector in the area, who, pitied but unabused, was allowed to pursue his excursions in Apache territory.

Although Kusche's was a passive application of the entomologist's mantle, it has also been used aggressively in the field of commercial espionage. There are instances of unscrupulous mineral exploiters using the collector's net and field dress as a disguise to gain access to deposits otherwise off limits to outside prospectors.

Although collecting is a hobby to most, it forms a basis of enterprise for some and a profession for many. There have been several commercially minded insect enthusiasts who have made a business of importing, rearing, and gathering specimens to sell to collectors. Perhaps the most famous establishment dedicated to this purpose is the Butterfly Farm in the village of Old Bexley in Kent, England. The Farm was established in 1894 by L. W. Newman and is still supplying specimens to collectors all over the world. The Farm's most famous customer was Sir Winston Churchill, who commissioned it to naturalize several butterfly species on his property at Chartwell to enhance the beauty of the grounds. Presently, a similar butterfly farm and museum is operated in East Durham, New York, by Mr. Max Richter, and several others have flourished for brief periods in the past in various parts of this country and elsewhere.

Many specimen dealers have "lost their shirts" in the business, but at least one famed individual literally kept a shirt on his back through the sale of butterfly wings. This was René Belbenoit, successful escapee from the horrendous French penal colony Devil's Island. As a *libéré*, he kept alive by catching butterflies in the Guinean jungles and selling their wings to French officials in Cayenne.

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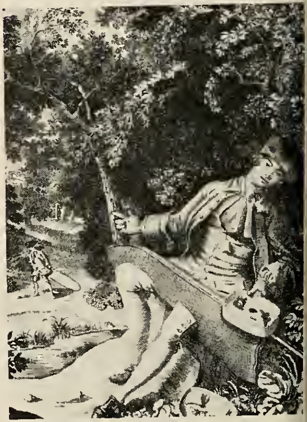
From varied fictional sources, especially Gene Stratton-Porter's *A Girl of the Limberlost*, and from occasional Sunday supplement articles depicting John Doe, amateur entomologist, standing before his dead butterfly menagerie valued at many thousands of dollars, many persons have come to believe that insect rarities may be worth untold sums to museums. Although eccentric collectors have paid large prices for unique, spuriously marked butterflies or moth specimens, serious minded biologists are seldom financially able or inclined to make such purchases. It is frequently necessary for the museum curator to disappoint expectant callers who ask, "I caught an odd moth, which must be rare because I can't find its picture in the encyclopedia—how much is it worth?" Large, well-cared-for, and accurately documented collections of an unusual insect group may be of some value to museums, however. Larger museums in the United States and in Europe do purchase many such collections. Most scientific specimens, however, have no real monetary value. Only in taxonomic groups where there is a popular interest—primarily butterflies and, to a lesser extent, beetles—is there any market value.

Prices paid for specimens as collector's items vary tremendously. At the auction sales held for many years at the Stevens' Auction Rooms in Covent Garden, London, normally marked butterfly specimens sold for a few cents, but aberrant individuals or rare species commonly brought from £10 to £25 ($28-$70). These rooms are said to have opened in King Street in 1776, and during the nineteenth and early twentieth centuries bidding was often hot and heavy and no less competitive than auction sales of antiques or other more popular items. Such auctions are still held, as in the case of an important private collection of exotic butterflies and moths (the Rousseau-Decelle Collection) recently advertised for sale at auction in Paris.

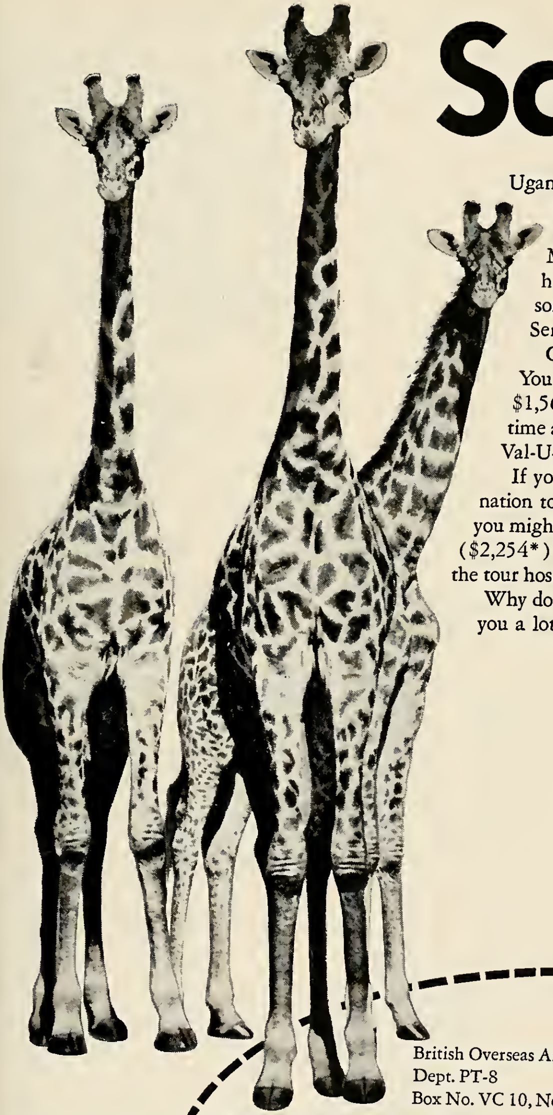
Collecting is a necessary aspect of the systematic study of any kind of historical or natural item or class of items. Specimens represent samples of nature that are stored like library books for reference and comparison, and serve as material from which hypotheses are made and extended to living populations or assemblages.

The world's large insect collections contain many million such specimens. The largest resides in the British Museum—Natural History and consists of approximately 28 million insects. In America the greatest collection is in the Smithsonian Institution, U.S. National Museum, and comprises approximately 17.4 million specimens. Other large collections in the United States are held in The American Museum of Natural History (nearly 14 million), California Academy of Sciences (5 million), and Harvard University (5 million).



Insects were captured with bat foule nets by early collectors pictured in an eighteenth-century text.

Insect specimens, if properly prepared and housed, will last indefinitely. The durability of the insect's body is due primarily to a hard and resistant cuticle making up the bulk of the exoskeleton. As a result there are some very old specimens extant in the world's museums. Of the 5,43 insects (and related creatures) in th original Sloane Collection, whic formed the beginning of the Britis Museum collections in 1753, the now remain 2,300 in good conditio pressed like herbarium plants. Oth special antique treasures among i sect specimens in the British Museu are the first insect specimens fro America, collected in the seventeen and eighteenth centuries, and Charl Darwin's material from the voya of the *Beagle* (1831-36). Also London, at the offices of the L naean Society (Burlington Hous are many of the original insects fi studied and named by the famed s tematic naturalist Linnaeus in t



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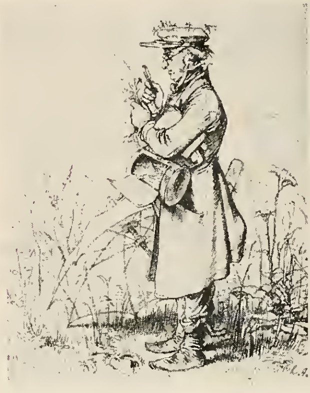
early 1700's. A butterfly (Bath White) captured in May, 1702, in Cambridgeshire remains in the Hope Department of Entomology, Oxford, probably the oldest mounted butterfly in existence. The oldest specimen of any insect is purported to be a dragonfly in the British Museum, from Petiver's Collection dated 1700. Large-scale collecting was done even earlier, in preparation for the natural history compendiums of Aldrovandi, Gesner, and others during the Renaissance.

Some of the earliest clues to the habit and equipment of the early collector are found in a folio published in 1766 by Moses Harris, entitled *The Aurelian*, which depicts and describes the British butterflies. The frontispiece shows the curious apparatus used to catch such flying insects. This device, called a "bat fouler" or "fly net," was designed to snare bats or birds but was adapted to the cause of the bug hunter. Early illustrations show it among the entomologist's preferred paraphernalia; the bag net (racket net or ring net) universally used in modern times was only a reserve weapon.

In the absence of appropriate chemicals, the earliest collectors exercised much ingenuity in devising ways of killing the specimens they caught. The simplest procedure consisted of pinching the insect's thorax. Killing jars containing crushed laurel leaves (cherry laurel, *Prunus laurocerasus*) were also used. The leaves released prussic acid fumes (cyanide



Uncle Jotham's boarder? This well-equipped collector held his umbrella under shrubs to catch falling insects.

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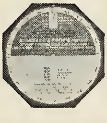

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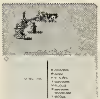

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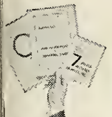

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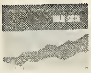

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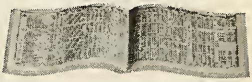

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gas) and were the forerunners of the modern cyanide jar. Other means of killing a specimen included placing it in a pill box and heating it over a flame, plunging it into hot water or spirits of wine (alcohol), impaling it on a hot wire or pin, and touching aqua fortis (nitric acid) to it. Sometimes the insect was placed in a tumbler, which was then inverted on a table. A bit of burning tinder was slipped under the edge of the glass soon filling it with smoke, which stupefied the insect. One early American collector, Professor Peck, killed minute insects by putting them into the hollow of a quill stopped with a piece of wood and holding it over the flame of a candle.

Collections were kept in bottles of spirit and in cabinets, or pressed or crudely pinned in boxes, but the emphasis was on displaying a variety of species rather than preserving an adequate population sample to show individual variation as is done today. This is understandable since animals were considered immutable varieties in the biblical sense, Darwin's influence not having yet been felt.

Particularly in England, France, and Germany, insect collecting has long been a respected hobby, and its popularity seems to rival that of some sports. This has not been the case in the United States. Membership in amateur insect collectors' clubs may serve as an index to the comparative status of the hobby. Britain's Amateur Entomological Society, catering mainly to the London area, had about 800 members in 1963. In contrast, the Lorquin Entomological Society of Los Angeles (serving most of Los Angeles County, an area roughly comparable to London in population and communication) had a membership of only 100 in the same year.

Why insect collecting is not more popular with Americans is hard to understand. Perhaps this is an instance of our alleged "cultural immaturity," perhaps an apathetic reaction to the biologic abundance of this country, as contrasted with the relative scarcity of flora and fauna in Europe. But despite the lack of widespread popularity, the zeal of the American bug hunter is equal to that of any other. The collector's passion remains undiminished by the crossing of national boundaries and by the presence of any prejudices against his pastime.

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Chang Sook writes to the Selettis. She also sends small homemade gifts to Alexandra. And she tells them of her dreams of becoming a nurse. She'll probably make it. If she does, the Seletti's investment in one girl will be repaid a thousand-fold.

The Selettis know they can't save the whole world for $15 a month. Just a small corner of it. But, maybe that is the way to save the world. If there are enough people like the Selettis. How about you?

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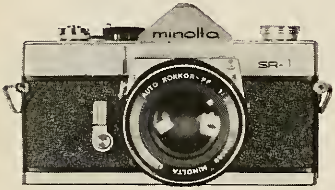

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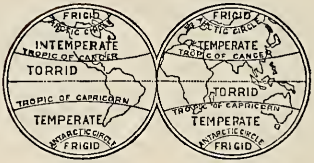

A Naturalist at Larg

The door from the living room into the "experimental rain forest," which I described in the March column, has one of those Chinese beaded curtains hanging behind it, to prevent birds from flying through into the house when the door is opened. I got the idea from the walk-through hummingbird exhibit at the San Diego zoo. So far it has worked perfectly, the birds apparently fearing to entangle their wings in the strings of beads.

When I take visitors out there, the first thing that is likely to happen is a thorough inspection of the strangers by Brunhilde, a female Blue-throated Hummingbird (*Lampornis clemenciae*). She has a habit of hovering directly in front of their eyes, which can be frightening for people without eyeglasses. We have thought of keeping a pair of plain spectacles to lend such people, although she has never really gone so far as to try probing an eye. If the visitor is a woman with a brightly variegated dress, the colored spots are likely to be carefully investigated, and Brunhilde is usually interested in a ring if it has a brilliant stone. In the case of a man with a sweater, she sometimes tugs at fibers, as if testing possible nesting materials, although I have never seen her make any effort at building a nest and have never been able to figure out what type of sweater will arouse her interest.

Each bird has a personal name, because each has a distinctive personality—a fact often stressed in the writings of Niko Tinbergen and Konrad Lorenz, and often ignored by psy-
chologists studying the comparati
behavior of different species of an
mals. Brunhilde got her name b
cause she was sent to me along wit
two males of the same species by
friend in California, Robert Lasie
ski, who had been studying hun
mingbird metabolism. Bob has no
moved to the other size extren
among birds—working with ostrich
and emus. One of the two males w
lame, and hence named Loki; t
others logically became Siegfried an
Brunhilde. Both males died within
year or so after their arrival, one b
cause of an injury to his bill (alwa
a hazard with hummingbirds), t
other for reasons unknown. But the
never did show much interest
people or in anything else, except o
casional fights between themselves
with other hummers in the room.

In writing about my birds, I w
almost inevitably sound anthrop
morphic, which is one of the cardin
sins of science. I have also been a
cused of teleology—the attribution
purpose. I am not sure whether th
is a sin, a misdemeanor, or a maj
crime, but it is clearly reprehensib
Neither of these vices has ever bot
ered me much, though I have oft
been scornful about the attitudes
other people toward animals—t
classic case of ladies in mink co
worrying about the treatment
white mice in laboratories, for i
stance. (Does anyone worry abo
the hens cooped up in tiny cages
those modern factory-like establis
ments that produce millions
eggs?) I think it possible that r

Continued on page

OIL STOCKS TO WATCH NOW

The "Little Fellows" Merit Special Attention

In an industry that abounds with "super-giants" — nearly half the 40 leading Oil Stocks covered by The Value Line Investment Survey show annual sales of more than a Billion Dollars — we expect the 12 months directly ahead to be "The Year of the Little Fellows."

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The Changing World of the Cree

by Norman A. Chance

photographs by Paul Conklin

r the Indians, adjustment to an encroaching civilization involves learning new trades. Using the chain saw is a relatively fresh experience for the Cree, but it is only a first step. In the rapidly mechanizing forest stry, as well as in the mines, more complex skills must be learned quickly to compete with skilled whites.

Three hundred miles north of Montreal, Canada, halfway between James Bay and Lake St. John, 1,200 Algonquian-speaking Cree Indians of the Mistassini and Waswanipi bands face a crucial decision. For centuries the forested land, lakes, and streams of north central Quebec provided these people with the three basic staples of their economic life: fur, fish, and game. And for centuries the seasonal pursuit of these staples determined the tenor of Cree life. Each fall, small groups of related families traveled by canoe to their hunting and trapping territories, returning in the late spring to the "reserve," or reservation settlements, on Mistassini and Waswanipi lakes. Winter required hard work and considerable social solitude. Summer, on the other hand, was a time of relative relaxation, of dances, marriage feasts, trading at the local Hudson's Bay post, and other social events made possible only by the temporarily increased population of the reserve community. Until recently, social change was perceived by the Cree to be a product of this annual cycle rather than an expression of permanent, non-periodic changes in their way of life.

The perception of the world varies with the culture of the observer. In recent years, more industrialized Euro-Canadians have come to view the land, lakes, and streams of the Cree in terms of large stands of marketable pulpwood, valuable minerals, and the potential for developing extensive hydroelectric power. In 1966, a major Canadian pulp and paper company constructed a multimillion dollar mill and town near the Waswanipi reserve, and the officials are now actively recruiting a labor force of over 1,000 woodcutters and 300 millworkers. Copper and other base metals are being extracted by large mining companies. New roads have cut through old Indian trapping grounds, and medium-sized towns like Chibougamau and Chapais have risen on the site of earlier Indian encampments.

The impact of these economic developments on Cree Indian life is profound. Three years ago, the entire population of the Waswanipi band moved off their isolated reserve in search of temporary or full-time jobs in nearby lumber camps or with mining prospectors. Some families have clustered in small extended kin-groups along a new gravel road that links several frontier towns. Others have migrated to white population centers.

The Mistassini Indians, on the other hand, have been less mobile, although here too, increased numbers of young men and women are moving off the reserve in search of economic and social opportunities elsewhere. Jobs are fairly abundant in the region, but they often require a knowledge of the French language—a skill held by few Indians. As a result of early Protestant missionizing, the Cree are affiliated with the Anglican church and thus receive their education in Quebec's English-speaking, Protestant school system.

At present, many of the older Indians prefer to bypass the new employment opportunities available to them in favor of more traditional ones. At Mistassini Post, over 50 per cent of the men still engage in trapping as their primary occupation. Fewer of the younger men are spending winters in the bush, however, and those who do often find their earnings are not sufficient to buy the consumer goods and services they now desire.

Here, then, is the crucial decision faced by the Mistassini and Waswanipi Cree: Should they follow the life of the traditional trapper, whose present income is viewed as submarginal, requiring supplementary government welfare "rations" and seasonal labor? Or, should they look for work in non-Indian employment centers?

Many Indians would like to take advantage of a steady cash income if they could continue to live on the reserve. As the Cree become more restricted to a limited area, the concept of *their* reserve—as opposed to land owned by non-Indians—serves as a focal point of their identity. Fear of losing one's distinctiveness as an Indian is often expressed by those who migrate to the towns and cities.

Given the natural wealth of the region, one might expect that proper vocational training would enable those Cree wishing to remain on the reserve to exploit their own land. This is not possible, however, since the Indian reserves in this area were allocated as residential settlements only; the amount of land available is too small to exploit profitably. A few jobs are available on or near the reserve in government-sponsored commercial fishing and sawmill operations, but these positions provide adequate incomes for only a relatively small percentage of the expanding Indian labor force.

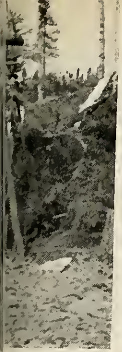
Under these circumstances, it appears that the economic future of the Cree is of necessity closely tied with that of non-Indian controlled industry. The extent of economic growth will be largely determined by the level of occupational skill attained by Indian workers and by their capacity to adjust to steady wage labor. To assist in this task the Indian Affairs branch of the Canadian government has set up vocational training programs for Indians no longer in school; it has tried to stimulate greater efforts toward community development and local self-government in various Indian residential centers; and it has provided improved family housing for those remaining on the reserve.

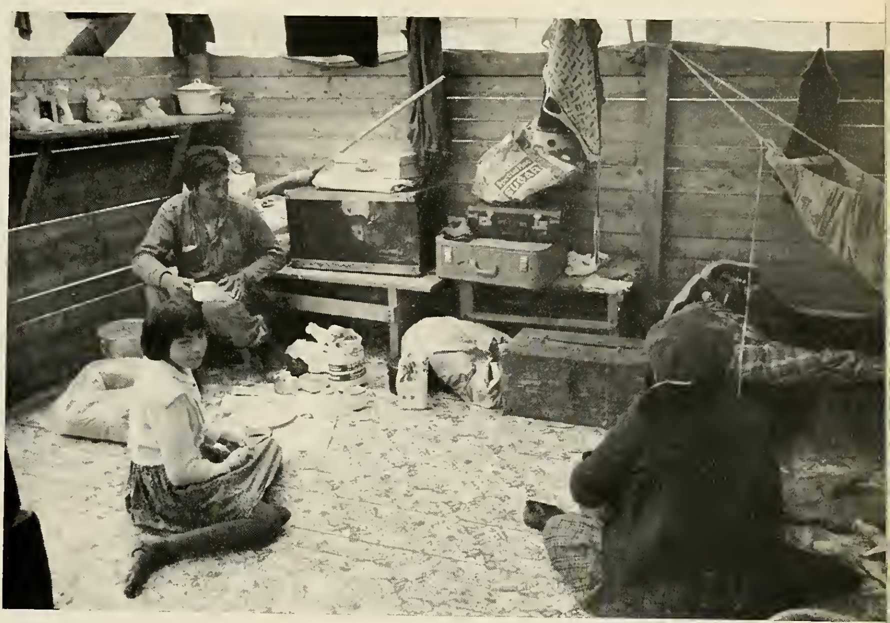
The crucial test, however, rests with the young Indians now coming out of school. The first five or six years of the child's life are almost wholly Cree in character. He learns the Cree language and family authority patterns, and the traditional Indian norms and expectations appropriate to his age and sex. His contacts with white men are peripheral, perhaps watching summer tourists take pictures at the Post, or visiting the Indian Agent's office with his father.

For the past decade, however, children of parents returning to the bush each fall have been sent to boarding schools located in industrial towns far from home. Just when the child reaches the age where he is prepared to assume a responsible role in Cree family and social life, he is placed in a modern residential school for Indians.

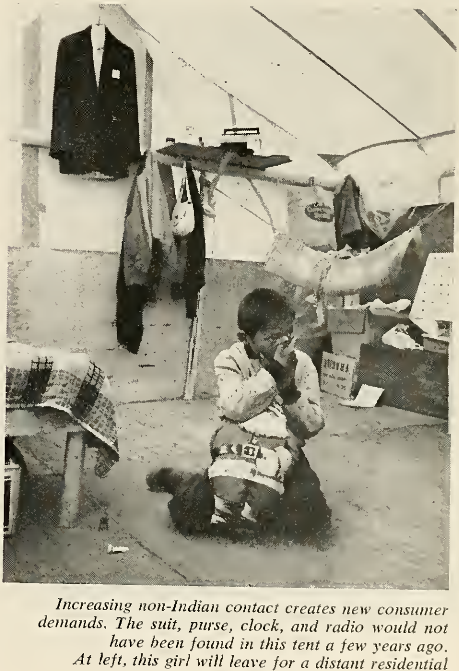
Many families migrate during the summer to live near places where jobs are available. Eight people live in this tent, which is pitched near a pulp operation.

Government housing, in some ways like middle-class suburbia, is not particularly practical for subarctic living, but the Indians accept it enthusiastically.



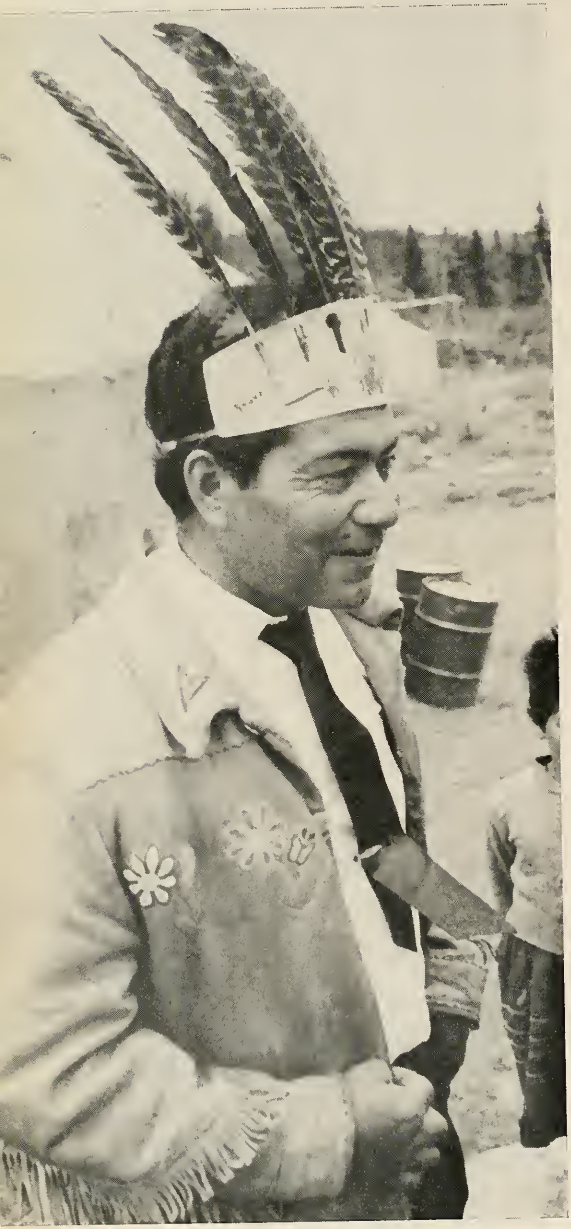


Lunchtime for a Mistassini family. On the menu are bannock, jam, sugar, and tea. It will be the same tomorrow. It was the same yesterday.



Increasing non-Indian contact creates new consumer demands. The suit, purse, clock, and radio would not have been found in this tent a few years ago. At left, this girl will leave for a distant residential school when her family returns to the bush.

A weekend on the Post is a time of celebration for these youths who work for mining prospectors. They enjoy a steady summer income and some, unlike their fathers, will probably not return to the bush in winter.



Special status can be asserted by clothing such as the moosehide jacket and the headdress. The latter is a souvenir gift from a neighboring chief.

Getting a haircut on his mother's lap is an emotionally rewarding experience for this boy. Close body contact is a major feature of Cree childhood.

ere, instructed by teachers speaking a strange and ini- lly incomprehensible language, living in a large dor- tory, and eating different food, the child spends nine onths of the year. His teachers know relatively little his Indian background and see their major task as eparing him for life in a modern industrial society.

Each summer, when the child returns home, the con- t is repeated. Contrasting the two worlds in which he es he finds that his parents know as little about his ool experiences as his teachers know of his home life. e only individuals with whom he can discuss both rlds—the only people who have faced a similar prob- n—are his age-mates.

his type of discontinued learning, carried through pri- ry and high school, places considerable strain on the ng student's personal identity. To choose consciously way of life over the other, the Indian must either ect those with whom he has had emotional ties since ncy or, conversely, those upon whom he has been endent for nine months of the year. In either event, the time the Indian youth is ready to leave school, he es an identity crisis. In school he has been taught to rk hard and to make his own way in the modern rld. If he returns home, he will be expected to follow ny of the traditions of his Indian past, one of which y involve allowing his parents to choose his future rriage partner.

or the Mistassini and Waswanipi Cree, it is still too ly to determine which path the majority of young ians will take. Whatever the future holds, it will de- d partly on their ability to understand better the world which they are becoming a part. And it will depend the ability of others to assist the Indian in maintaining nse of self-respect in situations that often foster self- aragement through lack of understanding.

Although the old people are willing to agree that things must change, they are the ones who maintain and pass on the traditional Indian ways.

A pause during a dance is a good time to gossip with visiting relatives. The Cree enjoy music; it is an important part of their summer social events.

A wedding celebration would not be complete without dancing. The fiddler plays strathspeys and reels, which he learned from traders long ago.

Teen-agers organized the Little Beaver Club where they dance and listen to popular music. The club helps the transition between school and home life. The future of the Cree depends on the youth, who must decide whether to maintain the old ways or adopt new ones.

CAPE COD

Laid out originally by mile-high continental ice sheets and ever since consumed and, at the same time, embellished by the sea, Cape Cod National Seashore is vibrant with daily geologic drama

by

Barbara Blau Chamberlain

A thin arm reaches seaward from the Massachusetts mainland, arched northward at the elbow and ending in a clenched fist. Quiet bays and sounds lap the inner part of the arm, from shoulder to elbow. But its outer stretch, the narrow land from elbow to wrist, takes the full power of the open sea along its eastern shore. The arm is Cape Cod. And its outer stretch, backboned by a glacial moraine and swept by sea winds, is the location of the new Cape Cod National Seashore.

This outer Cape is a region of mighty forces and endless change. Headlands retreat and spits grow. Shoals and bars may rise to form land or melt away like phantoms. I have seen a ten-foot section of land on the outer shore vanish under the awesome strength of a northeast storm. But not far away I have also seen one day's activity in the slow creation of land from salt marsh.

This is the essence of the Cape Cod National Seashore—this endless, magnificent display of observable geologic creation and destruction. Whereas the great inland national parks are, as far as men's lifetimes go, finished geologic paintings, the Cape Cod National Seashore is a geologic sketchbook.

Last summer, when the tide was rising, my husband and I launched a light plastic rowboat on the Seashore's salt pond at Eastham, and rowed it through the channel and out into Nauset Marsh. There we let it float quietly where it would above the strange world of the marsh. It took us where we could not walk and where a larger boat could not go. Its gentle drifting did not disturb the scurrying marsh life or the sharp-eyed herons at the marsh edge, and we, leaning over its sides, drifted with it into another world.

Nauset Marsh, spreading out at the foot of a glacial moraine, is a transition zone like all of the Cape Cod Seashore marshes. These are no man's lands between sea and land. They range from muddy tidal flats, where you can go clamming, to grassy salt meadows that the Pilgrims once hayed. The salt meadows undergo shallow sea invasions only occasionally. Small rodents and birds even nest in them. But in the intertidal zone where we rowed, the sea rushes in every day, and most of the life is sea life.

Each creature of the huge marsh population, by the very processes of living and dying, was fertilizing the marsh floor beneath us. Additional nourishment was arriving with the incoming tide. Its waters brought silt through the harbor from beyond the protecting sand spit—silt that the surf had raked out of the Seashore's glacial cliffs. Marsh grasses catch much of this new delivery. Here it settles. And, infinitesimally, the marsh becomes shallower. Eventually, if such raising of the marsh floor can offset the effects of a slowly rising sea level, the marsh will become part of the land.

The Cape Cod National Seashore has an outstanding combination of biological and historical features, and a surplus of natural loveliness. These, like so many features of America, seemed to cry out, for years unheeded, for protection from the all-consuming bulldozers of progress.

Back in 1935, the National Park Service made a survey of America's eastern seaboard. It found vast stretches yet unspoiled, and it recommended that twelve outstanding areas be preserved as national seashores. One of these was Cape Cod's outer beach area. But it was to be another thirty-one years before this grand sweep of sea-molded shore and glacial upland would be protected from the building boom.

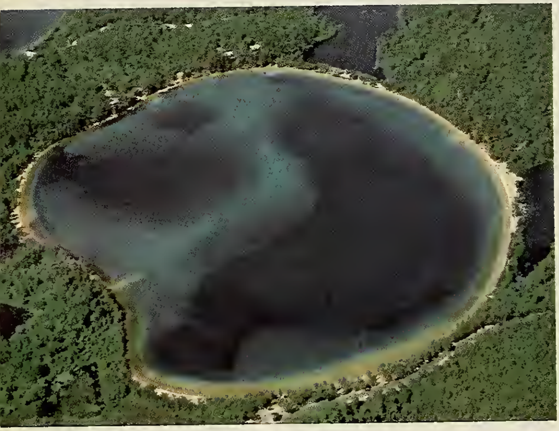
The tides that buoyed our boa on Nauset Marsh, the endless daily pulses against all Cape shores, are an intrinsic part of Cape Cod. But its actual creation resulted from different sorts of tides, long ago. Thei rhythm was measured, not in hours but in thousands of years. These were tides of glacial ice. It was some 30,000 years ago that they first rose and only 10,000 years ago—just yesterday to a geologist—that they ebbed for the most recent time.

Today, across the Seashore, pin forests and bearberry heaths spread where there was once a mile-hig sheet of moving ice. But the glacia trail does not stop at the shore. Th quiet waters of Cape Cod Bay fill th vast basin that once held a bit of th front edge of a continent of ice stretching all the way back to Labrador. And on the Seashore's ocean side rise the massive, thirty-mile long glacial cliffs of sand, grave and rubble dumped by the ice t heights of a hundred and more fee Streaked with rusty colors, overhun at the crest with roots of unde mined trees and turf, dotted wit Bank Swallow homes, and aprone at its base with talus, this is the i constant, sea-sliced cross section the Seashore's glacial framework.

Late in the Pleistocene, or gre Ice Age, the Cape Cod glaciers bega to gather. A chilling world clima led to the formation of a massi snowfield on the rocky highlands Labrador. Ever increasing thickne and compression turned the snow ice, which eventually became so thic that, under its own weight, it sprea

Roving sand dunes of Provincetow hook will frequently bury—and occ sionally unbury—stands of trees.

Great Pond, one of the Cape's many kettle ponds, formed when the hole left by a huge, stranded ice block filled with ground water. These ponds have steep sides and no outlets.



Nauset Marsh lies at the foot of a glacial moraine, protecte from the ocean by a sand spit. A salt marsh, it has varie plant and animal populations; its shellfish are abundan

The surf rakes incessantly into the cliffs of rubble an till, the glacial framework of the Seashore. This region average coastal erosion rate is three and a half feet a yea

slowly outward in all directions, like soft dough. As it oozed forward, branching around irregularities in the terrain, its margins took on a scalloped, or lobate, form.

Gradually, backed by overpowering bulk, three of these lobes spread down across southwestern New England (*see map, page 29*). They widened its valleys. They scoured, scraped, and stripped its rocky hills. Thousands of tons of New England's soil and bedrock, incorporated into their bodies, traveled southward with the glaciers.

As the ice moved, ground friction scraped off part of its tremendous earthy cargo. This remained across he ground as a veneer of glacial ubble, or till, to mark the glacier's path. Sometimes excessive frontal nelting caused the ice to pause. When this happened, an especially hick ridge of debris, or a moraine, grew along its margins; for always ew ice was pushing down from the orth and bringing new material. In he New England–New York region, he ice did not get beyond the lati- ude of New York City and south- astern New England. Of course, ere at its farthest southern limit, ere was copious melting, and par- cularly large moraines piled up.

Thus, at the end of the bitter lacial years that had gripped New ngland, new lands rose from off- ore waters, with moraines for ackbones. These included today's ape Cod, Martha's Vineyard, Nan- cket, and to the southwest, New ork's Long Island. They are inti- ately related, for the same ice lobes ilt them all.

Each of these lands actually grew ore by spurts than all at once. The e here, in its southernmost reaches, is in hostile territory, and the moderate temperatures and warm ocean rrents teased its southern margins. veral times its lobes advanced and reated. Each southward sortie left new blanket of till, fronted by raines, to mark its route.

Eventually, as a warmer climate urned to the earth, New England's ciers began to melt, to release the d, and gradually to lose their ntities in the seas. During their t days, the Cape–Island lobes gered long enough to put the finishing touches on lands they already had blocked out. They laid a final layer on Martha's Vineyard and Nantucket, then pulled still farther north, as far as Cape Cod's present outer arm. There one lobe helped to build the moraines of Cape Cod's inner arm, from shoulder to elbow, while across the Bay it laid down Plymouth Rock.

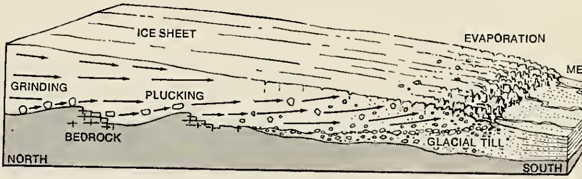
This lobe had an eastern twin, to which it was joined on the north. Together they reached down like spread fingers, forming an angle between them that widened southward. It was these ice fingers that built up the outer Cape and the bulk of the Seashore.

Most of the time, one lobe filled the basin of Cape Cod Bay. The other lay with its inner margin some two miles off the Cape's present eastern shore. Of course, both were mainly aground, since much of the earth's water that ordinarily would feed the sea, fed instead the vast army of glaciers across the world's higher latitudes.

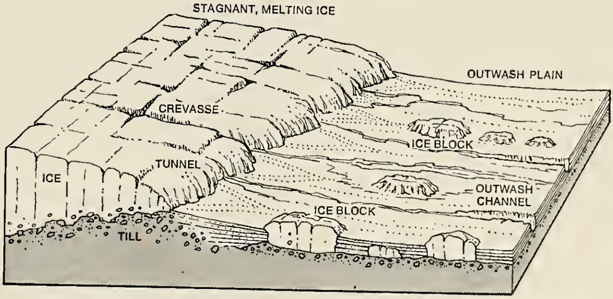
The melting along the edges of the New England lobes produced meltwater rivers. These snaked their way over what must have been a most desolate sandy waste between the lobes, and carried layer after layer of rocky rubble from ice to land. The glacial section of the Seashore is essentially a thick stack of such layers; you can see them in the eroding cliffs.

There are other signs of glacial meltwaters in the cliffs, too. Every few miles they dip down in what Cape Codders call "hollows," low sags that may reach clear across the Cape as wide valleys in the landscape. In times of excessive melting, glacial streams swelled to powerful torrents, capable of deep erosion. With their abrasive cargoes of earth material, they gouged the landscape like huge chisels. The Cape valleys that they carved in the cliffs sometimes provide the only route to or from the beach.

Some twenty ponds dimple the Seashore landscape, each marking the onetime site of a huge, stranded iceberg. Such chunks broke from the melting ice and in time melted too, of course, but first they lingered long enough to become covered and



The glacier carried everything from sand to huge boulders on its journey south. As the ice retreated, it left glacial till behind.



Each lobe of the melting ice sheet created a moraine from the bulk of its debris. Channels were cut by torrents of meltwater rivers, and kettle ponds formed where ice blocks had been stranded.

Great Beach, the magnificent forty-mile-long, sandy outer beach, helps to protect the crumbling moraine from the full force of the attacking surf.

Coastal erosion has been so great that this Marconi Area shelter, originally built 160 feet back from the cliff, now enjoys a superb ocean view.

surrounded by gravel laid down b
glacial streams. When the ice bloc
vanished, they left huge depression
or kettle holes, in the gravel deposit
After the land's return to normalc
ground water filled many, formi
today's kettle ponds and swamps.

During the recessions of the i
there were times when it drew ba
far enough to open the floodgates
seawaters, which surged over t
sandy glacial plains laid bare by t
ice. In the same way that the me
water streams left rubble from t
glacier across the land, the seawat
laid down their own layers of mari
sands and clays.

This, then, is the framework of t
Cape Cod Seashore—this layer
modified glacial moraine, perha
some 20,000 years in the buildi
We see little on the Seashore tod
aside from the actual ups and dow
valleys and ponds of the terrain
self, to call to mind its newborn
pect. For it was a harsh land at fi
all hardscrabble and barren of li
Even while more northern regi
still had the weight of a dying glac
on them, however, the Seashore a

was sprouting seeds and forming soils. And in time the land grew green and gentle.

The palpable glacial souvenirs that make up the Seashore landscape –glacial plains, sea cliffs, layers of ill, kettle ponds, and hollows—are nly part of the Cape story. The sea nd the sea winds write the rest.

The newborn glacial outer Cape esembled only vaguely the 10,000-ear-old Cape we know today. When he ice went, the sea arrived—and he sea is insatiable. For 10,000 years s assault against the friable materils of the moraine has been incessant. ut at the same time it has been uilding, too.

The early outer Cape was much ider and blunter. It reached seaard some two miles beyond its resent eastern shore. Not only its in wrist and great Provincetown st, but also the long elbow spits of auset Beach and Monomoy are orks of the sea. As these newer lditions grew—and they are growg still—the central glacial outer ape narrowed; for it was from is that the ocean stole its raw aterials.

Immediate by-products of the a's early assault were the sandy aches that still frame the Cape. e magnificent forty-mile outer ach, with its central high-cliff ckdrop, is the Seashore's prime ason for being. Thoreau called it Great Beach: "A man can stand re and put all America behind n." It is a buffer zone between mbling land and open sea, deposry of the broken timbers of more n three thousand ships, part-time me for hundreds of bird species, ing laboratory of geology, witness history, and source of recreation l inspiration for millions.

But the beach is just a sideline in sea's dual job of destruction and ation. At the moraine's highest tion in Wellfleet, there is a Seare public area on clifftop, with a gnificent view of the ocean's ndeur, built on a vivid example its power.

This is the Marconi Area. Some y-five years ago this site was sen for Marconi's successful first satlantic wireless station in erica. Four great transmitter towers rose on a concrete platform; from these a hallway led eighty feet seaward across the plain. The builders, taking care to be safely back from the cliff, allowed about a one-hundred-foot margin. Today the tower platform remains, and from it you can still follow the hallway seaward, some twenty feet. But there you must stop—at the cliff edge. If in 1902 the hallway reached sixty feet beyond the present cliff, and was still more than one hundred feet back from the cliffs of that time, it is clear that in little more than half a century, one hundred and sixty feet of moraine have gone to the sea.

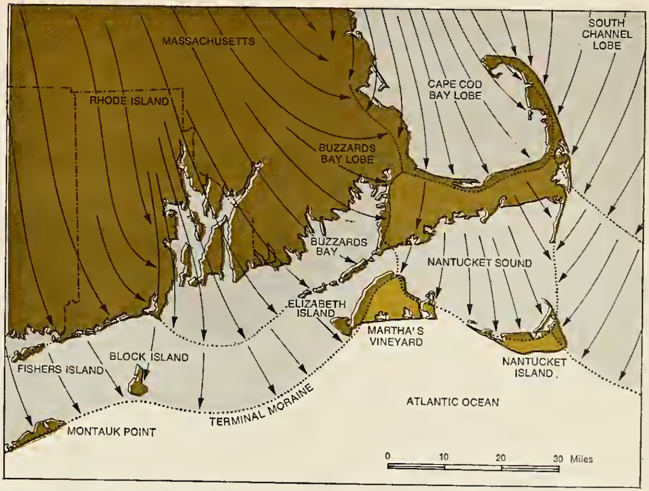
Considering that the cliffs here are more than one hundred fifty feet high, this is a colossal volume for the sea to have dispersed in so short a time. Yet it is still less than this region's average coastal erosion rate of three and a half feet a year. And since the attack has continued for a hundred centuries, it is no wonder that the outer shore has been driven back two miles.

The moraine's earthy bulk is subject not only to daily winds and rains but also to the full power of North Atlantic storms. These sweep in across hundreds of miles of open water. They put on a splendid show, driving the sea against the land and undermining its very foundations.

The surf is a formidable assailant. A storm wave may grow forty feet high and five hundred feet long and batter the land with a pressure of six thousand tons per square foot. When such a wave crashes into the cliffs, it compresses the air held within pore spaces of cliff debris. This bursts loose like an explosion, and takes entire sections of the cliff with it.

Those who live on the outer Cape take as a matter of course the yearly harassment of clifftop parking lots and stairs down to the beach. They know that even their lighthouses are never permanently safe. Four times Nauset Light at Eastham has had to be rebuilt farther back, as the previous foundations toppled into the sea. Cape Cod Light at Truro, where the erosion rate is sometimes eight feet yearly, stands on a dwindling tract of land that has shrunk by seven acres since it was bought in 1787.

The boundaries of the Seashore today include all of the outer beach and as representative a section of the hinterlands as is practical. Its width averages a mile in most places. At the Seashore midsection, in Wellfleet, the glacial foundations are thickest. In one area the ocean cliffs rise as high as one hundred eighty feet. This central section is a high choppy



On its way south from Labrador, the glacier became scalloped; individual lobes flowed in different directions as shown by the arrows. The dotted lines indicate where the ice stopped and deposited its debris as moraines.

The marshes grow grass, the dunes are tamed by vegetation, and the Provincetown hook becomes larger.

upland, a wild country of bayside heaths grading into oceanside pine forests and stands of salt-stunted, gnarled scrub oaks—nearly a century old but only two inches across.

This is where Seashore boundaries take the widest slice of the Cape, cutting clear across from the outer beach to Cape Cod Bay. The Bay is the fisherman's world: of wharf and weir; of far-out nets that are harvested daily, not by boat, but by truck when the tide is low; of oysters and quahogs and mile-wide tidal flats spread out in front of wrack-lined beach and glacial bluffs.

Herring River, a salt river, crosses the Cape here and nearly ties ocean to bay. There are several such rivers occupying the broad channels that glacial streams gouged across the landscape. At the wide, salty mouth of Herring River on the Bay you can start with fiddler crabs and marsh grass, travel up along the channel through snapping turtle–bulrush country, and end at its head in a kettle pond, among deer and black alder, nearly at the ocean shore.

Lower glacial plains flank the massive midland section of the Seashore on both ends. Those to south are the mesa-like tablelan of Nauset, eighty to one hundred fe high, and these give way, still farth south, to a rolling belt of ced covered glacial hills. It is these th form the backdrop for Nauset Mars

To the north, at the opposite e of the high central plains, the la drops down and gives way to the lo rolling North Truro Plains. The end abruptly on their north in blunt glacial hook. This is the end the glacial Cape.

This bluff, long known as Hi Head, recently has been renam Pilgrim Heights. For this is Pilgr country. Several trails lead throu woods and meadow, one to t spring where the Pilgrims are l lieved to have found their first N England water.

Once the entire Cape ended he where the glacial Cape ends tod The open sea carved this cliff, be ing against the Cape here as it n beats against its eastern shore. Th Pilgrim Heights is actually a cliff, stranded high and dry. Oce

Herring River cuts behind the m aine in an ancient glacial chan winding nearly across the Cape.

rrents have thrown up a sandy m, which keeps the sea out and has lowed a lake and marshes to spread t at its foot. In fact, such sea-laid rrent deposits reach from here ong the Cape's narrow wrist and the way to its tip at Province-wn. This entire section of Cape d is sea-built land.

or the vast volume of eroded debris torn from the land does not nain forever awash. The sea must pose of it. And this is where new ds rise from the old. As the sea ces back the glacial land, coastal rents catch up much of the ma-ial. They carry it along the coast l drop it where the land ends or nges direction. Whatever fine silt vincetown fails to snag continues und to blanket the floor of Cape l Bay. Already the Bay's tidal flats so shallow that, in places, daily tides bare more than a mile of floor.

ut the great Provincetown hook, ling entirely on the Seashore's raine to its south, is the ocean's major contribution. It is still growing. As the sea attacks the outer coast it sends its currents sweeping around Provincetown, tacking sand onto the spits that trail off from the hook.

The combination of speeding currents and shoaling sea floor has made the coast behind Provincetown one of the most treacherous parts of a treacherous seaboard. There is a Seashore lookout platform commanding a view of the coast near Provincetown's Race Point. This section has claimed more wrecks than any other part of the Atlantic coast.

A sandy, exposed, and windswept land, the sea-built part of the Seashore is dune country. All of Provincetown is dunes, some old and subdued, others young and aprowl. The town of Provincetown itself, outside Seashore boundaries, is built on dunes that were tamed long ago by a net of vegetation. But outside the town, all the way to the edge of the sea, giant ripples of white, pristine sand, some fifty feet high, roll like slow, creeping waves over all before them. Such dunes keep road crews busy along the highway. Throughout this wild, shifting country one can spot stands of trees, either partly overcome and still holding on to life, or as gaunt black skeletons, once

comb's Hollow, carved in these s by a glacial river, is the area's route to the beach.

buried and now revealed again after the dune has rolled on. It is magnificent country for roaming.

The outer Cape's sweeping geologic epic of ice, sea, and wind is unmatched elsewhere along the nation's seaboards. When the Park Service completes its acquisition of all 44,000 authorized acres, it will have, in its moraines and sand spits, marshes, dunes, ponds, and beaches, a gem of dynamic geology.

But it will have other, equally outstanding features, too, for which geology has provided merely the stage.

The teeming life of Nauset Marsh is only a tiny fraction of the Seashore's unusually varied plant and animal population. Cape Cod plays a unique role as a wall between the ocean's warm Gulf Stream and its cold Labrador Current. This has given Cape offshore waters a wide diversity of southern and northern sea creatures, with about a thousand different species of sea life represented. Fishermen can have such choices as striped bass or swordfish belonging to warm waters, or cod and halibut belonging to cold.

As offshore the Cape's jutting location enriches its marine population, so onshore it serves as a way station for thousands of migratory birds. The Cape lies on a major North American flyway. Of terns alone, some eight thousand pairs nest yearly on one tiny island near the Cape elbow; and to keep bird watchers busy the rest of the year, more than three hundred song and game birds are Cape natives.

If the Seashore's birds are abundant, its plants are profuse. Many an inland visitor has conceived of the region as a barren sandbar and received a delightful surprise on his arrival. There are vast pitch pine stands, sand-rooted beech woods, red maple and white cedar swamps, saltmarsh meadows fringed with fragrant bayberry and beach plum, and in summer's full bloom, wildflowers everywhere. Finding shelter in this wide assortment of habitats are some three dozen mammal species, from tiny shrews to deer and harbor seals.

Of course the virgin forest is long gone from the Seashore, as it is from most of New England. Many of today's trees were introduced, notably the pitch pines. These were planted by early Cape Codders to tie down the windblown sands, and they have served admirably.

But strange immigrants share the Seashore with them. Indeed, this region is a sort of plant melting pot. Plants that belong far to the north and south live side by side. There are golden heather, bunchberries, and poverty grass, which came 10,000 years ago as part of the haze of green that fringed the glacier's margin. Then there are hollies and sour gum trees, for about the time the Normans were invading England, Cape Cod was invaded by a breath of southern air and southern plants. Although both northern and southern types are rarely found on nearby mainlands, both have prospered on the sea-tempered Cape.

Long before today's plant assortment reached the Cape in its present form, human beings were living on it. Some Seashore digging sites have yielded archaic artifacts 2,000 to 7,000 years old. Long gaps in the record follow. Then we find abundant relics of the Nauset Indians, a tribe of Algonquians. All of Nauset Marsh once belonged to a sachem of this tribe. Shell heaps here and there across the Cape are rich hunting grounds for tools and arrowheads

Provincetown's hook feeds on the Seashore's moraine to the south. Enclosed lagoon is Pilgrim Lake.

Race Point, with its unpredictable shoals and currents, is one of the Atlantic's most treacherous areas.

No one knows just how long the Cape was known to Europeans, but it was probably around the turn of the seventeenth century that the Cape Cod tourist business began. Bartholomew Gosnold (who named it), John Smith, and Samuel de Champlain, perhaps Henry Hudson and Verrazano, probed its coast.

Discovered and settled by seafarers, the Cape has always urned to the sea for its prosperity. Today it turns primarily to the sea- nd sand-seeking tourist. During the ighteenth and nineteenth centuries t was to whaling and commercial ishing. These left abundant mem- ries scattered across Seashore rounds, from the magnificent homes f the captains to the cemetery stones ommemorating those lost at sea.

This outer Cape—land born of ice, ea, and wind, setting for diverse lant and animal communities, and ite of a long and sometimes dra- atic human history—is a world nto itself. Now, with the establish- ent of the Cape Cod National Sea- ore, representatives of these unique easures are preserved where we ay enjoy, but cannot steal, them. or otherwise they might prove as sily eroded by progress as are their lacial frameworks by the sea.

It takes barely an hour to drive om end to end of the Seashore on e Cape's wide highways. There are me who do that and think they ve seen it. But they haven't. No one s. For the passing days and years ave patterns across the face of e Seashore and along its shores, unique and changing, often ephemeral, as the forms of a leidoscope.

You could spend a lifetime and ver see it all—watching the give d take of land and sea, feeling the rf's power against the crumbling ffs, seeing terns swoop for fish, ex- oring the surf-edge world of shells, bbles, and jetsam, or the piney in- d world of kettle pond and cattail amp. Or floating in a small boat er the living floor of a tidal marsh.

SKY REPORTER

Although some astronomers postulate that there may be thousands of millions of planets in the universe, no one has ever seen a planet circling another star. But there is direct evidence of dark companions revolving around other stars near the sun. Some of these companions are small enough to be called planets.

The list of these planetary systems is growing. A review in the journal *Icarus* assigns dark companions to 6 of the 100 nearest stars. All 6 are within 18 light-years of the sun.

The clearest case is that of Barnard's star, a 9th magnitude red dwarf in the summer constellation Ophiuchus. This star is just six light-years away and is moving through space at 85 miles per second relative to the sun. It appears to move through the sky at the rate of 10.3 seconds of arc per year.

But Barnard's star does not move in a straight line—it wiggles. This wiggle has been checked on photographs dating back to 1916. Peter van de Kamp of Swarthmore's Sproul Observatory, who led the study, is sure the wiggle is caused by an unseen planetary companion.

The force of gravitation exerted by the unseen companion pulls Barnard's star first to one side of its path, then to the other. By studying its effect on its parent star, van de Kamp and his group have deduced some of the companion's characteristics.

Its magnitude is about 30, too dim to be seen from earth. In comparison, Jupiter would have a magnitude of 24 as seen from Barnard's star. The companion revolves around the star at a mean distance of 4.42 astronomical units once every 24 years. Its surface temperature is—350° F. Its mass is 1.6 that of Jupiter.

Five other such dark companions have been detected, each by the wiggle it causes in the path of its star. In every case these wiggles, called perturbations, are just over the threshold of detection.

Perturbations can be observed only in the paths of nearby stars that are moving quite fast relative to the sun. Otherwise their paths among surrounding stars are too slow and too short for any wiggle to be apparent.

Even without telescopes in space or on the moon, additions to the list are expected. Van de Kamp worked with a 24-inch refractor at Sproul. The new 61-inch astrometric reflector at Flagstaff is designed for just such accurate work and may quickly lengthen the list.

TENTH MOON FOR SATURN

The first new natural satellite in 15 years has been discovered circling Saturn.

First spotted by a French astronomer in December, 1966, the object was later identified on photographs made at Flagstaff. It has been named Janus after the two-faced god of mythology.

Janus is Saturn's tenth moon, a 14th-magnitude object probably less than 300 miles in diameter. It whizzes around the planet every 18 hours just outside the rings.

Its discovery was not an accident. The rings appeared edge-on to earth December 17 for the third time in 1966. This edge-on position minimizes glare from the rings, making this the best time to look for new moons. The rings will not appear edge-on again until 1980.

NEW MOON RISING

The full moon is about as welcome at most observatories as a snowstorm. It not only blots out most of the sky with its glare but it even hides its own features in flat light. Thus the news that NASA is designing an artificial moon 1.7 times as bright as the real one was unsettling.

The NASA moon, a 2,000-foot mirror to be hung in synchronous orbit, could be used to expose enemy positions, to illuminate search-and-rescue operations, to provide lighting for blacked-out cities, and to provide more light in polar regions.

Some biologists have reacted against it, arguing that the artificial light could disturb the rhythms of plant and animal life. There was similar alarm among astronomers in 1963 when 480 million tiny copper wires were placed in orbit in a radio communications experiment. Their fears proved groundless, but a watchdog committee formed then is meeting with NASA officials on the mirror project.

John P. Wiley, Jr.

CELESTIAL EVENTS

Venus (magnitude −3.6) and Jupiter (magnitude −1.6) dominate the evening sky, appearing in the west soon after sundown. Mars, red in color and about −0.9 in magnitude, is in the southeast near the bright star Spica as night begins, and sets well after midnight. Saturn, a morning star, is not easily seen until late in May.

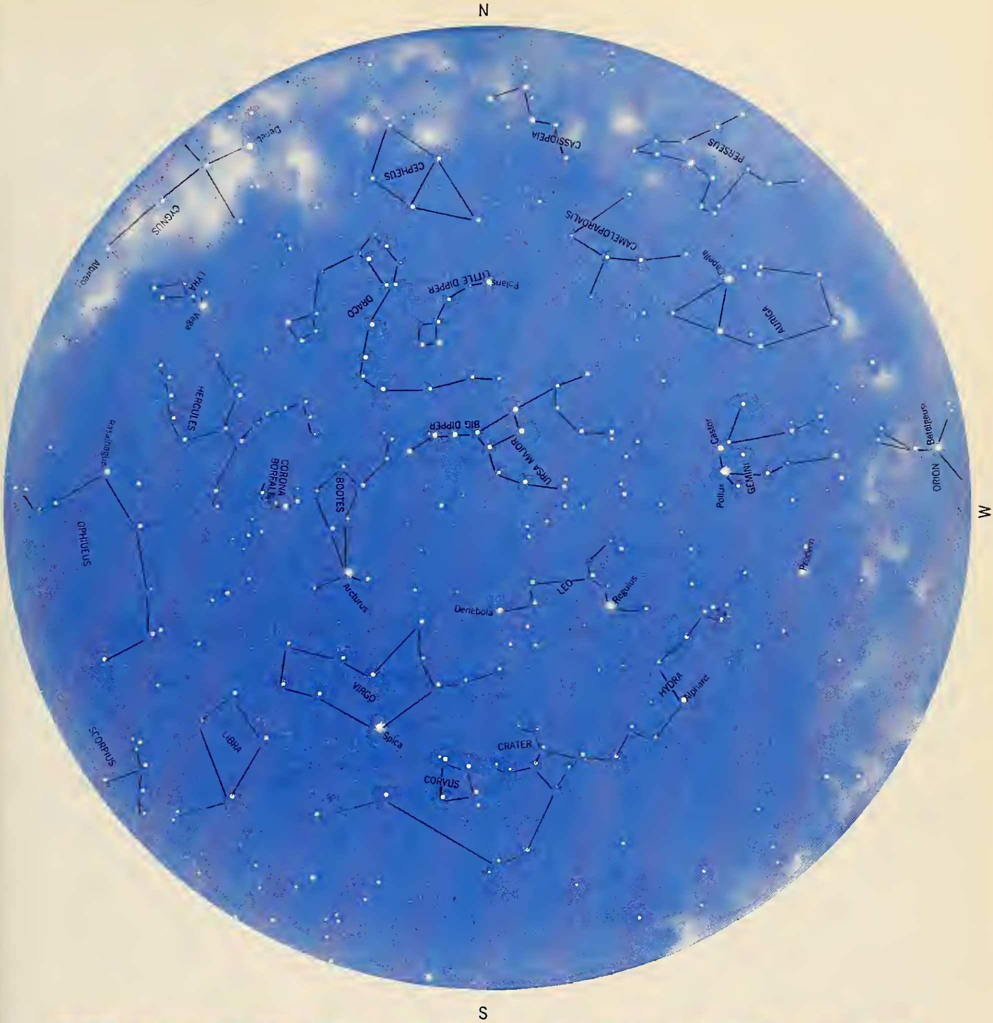
The shadow of the new moon of May 9 comes close enough to the earth to produce a partial solar eclipse, which will be visible generally throughout North America. The moon, moving past the sun, will obscure part of the sun from view. The moon appears as a dark, curved disk encroaching on the sun from right to left.

In New York, the eclipse begins at about 8:20 A.M., EST, and about an hour earlier in each time zone westward. The duration and magnitude of the eclipse varies with location. At New York it will last about an hour; farther north and west it will last longer.

The exposed portion of the sun during a partial eclipse is every bit as bright as an uneclipsed sun. Do not look directly at the sun, with or without optical aid, during the eclipse. The safest way to observe the sun, during an eclipse or otherwise, is to project its image with a telescope or pinhole, and to observe the projected image.

Thomas D. Nicholson

Hold the star map so the campass direction you face is at the bottom; then match the lower stars with those in the sky. The celestial events chart shows times of rising and setting of the sun, moon, and principal planets; times o twilight; and sundial correction during the month. Horizontal scale shows time; vertical shows dates. The top strip locates bright stars, planets, and the moon within the zodiac. The horizontal scale of hours shows time of meridian (due south and highest) at midmonth and at significan phases of the moon.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CASSIOPEIA
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Castor
Pollux
GEMINI
Betelgeuse
ORION
Rasalhague
CORONA BOREALIS
BOOTES
OPHIUCHUS
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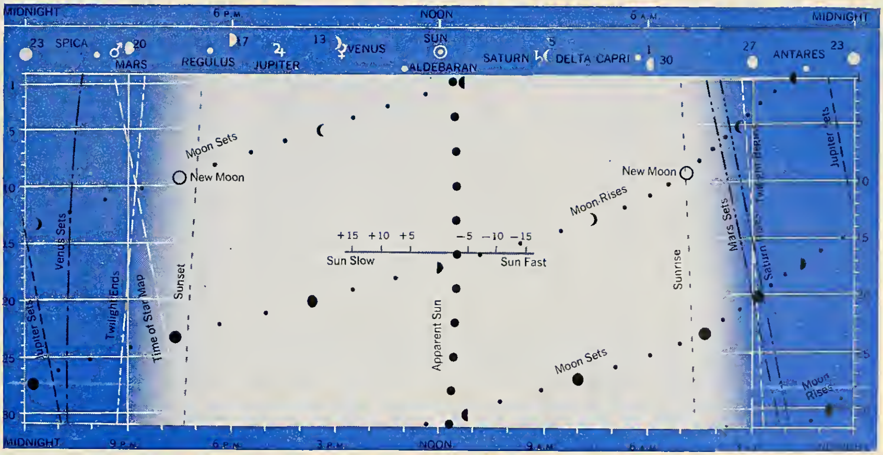
MIDNIGHT
6 P.M.
NOON
6 A.M.
MIDNIGHT
23
SPICA
20
MARS
REGULUS
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JUPITER
13
VENUS
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SATURN
5
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1
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27
ANTARES
23
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10
15
20
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30
Jupiter Sets
Venus Sets
Twilight Ends
Time of Star Map
Sunset
Moon Sets
New Moon
+15
+10
+5
−5
−10
−15
Sun Slow
Sun Fast
Apparent Sun
Moon Rises
New Moon
Moon Sets
Sunrise
Mars Sets
Saturn Rises
Twilight Begins
Jupiter Sets
Moon Rises
MIDNIGHT
9 P.M.
6 P.M.
3 P.M.
NOON
9 A.M.
6 A.M.

A Frog Comes To Hawaii

Captain Cook discovered a Hawaii without frogs. The six species of frogs now found in Hawaii are all recent introductions brought in largely as experiments in insect control. Of these imports, shy *Dendrobates auratus* is the most dazzling—a green-and-brown jewel from Panama.

The scientific name of this small, land-based frog—the adult is about one and a half inches long—means literally "golden tree frog." Actually, its "gold" is golden green, the rest is more like richly oiled mahogany, and *auratus* isn't truly a tree frog.

The colors of this gaudy animal are a touch-me-not warning, for, like the other members of his genus, *D. auratus* has skin glands that produce a highly toxic secretion. How toxic? One report states that the Indians of eastern Panama toasted the frogs over a fire, then made a paste of them and used it to poison the tips of blow-gun darts. On the less dramatic side, another researcher states that contact with the species *auratus* in a collecting bag is fatal to other frogs.

Dendrobates ouratus was brought to Hawaii in 1932 by David T. Fullway and liberated in upper Manoa Valley. This area is one of the wettest sections of Oahu and, at that time, supplied experimental grounds for a group of biologists and agriculturists interested in subtropical varieties of plants and animals. The frogs are now well established in the valley, and their future is apparently secure, the more so because the area has been set aside as a forest preserve.

These animals seem to prefer residence in abandoned gardens and old stone walls. But in early morning after a light rain, the frogs will leave their crevices in the rock walls to forage in short grasses or on the leaf-littered floor that they find in the subtropical forest. If the day continues dry, the frogs quit their general feeding and move to the fields of ginger and ape (*Xanthosoma robustum*) where the broad-leafed, fleshy growth maintains a high humidity and a constant supply of ants and other insects that browse on decayed material.

In the quiet of a moonlit summer evening, the adult male *D. auratus* do their calling in soft, buzzing voices, and mating ensues. At other times of the year, or when the nights are dark, the frogs are silent and seldom seen The Japanese frog (*Rana rugosa*), whose habitat overlaps that of *D. auratus*, often sits in patches of window light with toads (*Bufo marinus*) and geckos feeding upon insects. *Dendrobates auratus* is completely absent from these gatherings, yet during the day, it frequently feeds side by side with the Japanese frog.

Females of the genus *Dendrobates*, whose native habitat extends throughout much of lower Central America, normally deposit a single egg at a time. Where this is done seems to vary with conditions in different localities. Reports from Panama, for instance, indicate the eggs are laid in small, moist or water-filled depressions. When the eggs hatch, the male becomes a nursemaid, carrying the tadpoles piggyback—usually one at a time—to a permanent pool of water. Frequently, the pool is in a hole in a nearby tree.

Similar behavior has been reported in wooded areas of Hawaii, where small puddles appear in rainy weather only to dry up soon afterward. But in Hawaii there is also

The conspicuous pattern of colors is
hands-off warning that the skin glan
of diminutive Dendrobates auratus *g*
forth a poisonous secretion. The adu
above, is about 1½ inches long. Fing
at right, shows the relative size o
big-headed, frail juvenile. Precedi
this stage it spent about eight weeks
a tadpole in its nursery—water in
deep cup that is formed where the c
cave stem of an ape leaf joins the b
of the plant. The picture below sho
leaves of one ape plant at the le
stems of another at the right.

The gaudy but shy little import from Panama has adapted to its new habitat, with help from the ape plant

by Henry L. Ullman

heavy competition among amphibians for tadpole-rearing puddles, which are quickly filled with egg masses, especially those of toads. This may explain why shy and relatively small *D. auratus* more commonly uses another kind of hatchery—depositing its egg in the cup at the base of an ape plant, another introduction from Central America.

This plant has a cluster of overlapping, concave leaf stems; in mature plants they may be as much as three or four feet long. Each stem forms a deep cup where it joins the base of the plant, and a supply of from two to four ounces of water in this cup is periodically renewed with water that drains down the stem from the broad "elephant ear" leaves. This reservoir serves both as hatchery and nursery for the frog.

The breeding season, from May or June through September, is also the dry season in Hawaii. Even those wet areas in which the frog makes its home receive at best only scant rainfall each day. The ape cups, however, are always filled, and during the breeding season there is generally a tadpole in each of them.

The tadpole spends from seven to nine weeks in the cup. During that time it feeds on microscopic plant and animal matter, also on larvae and small insects entrapped by the water. The tadpole stage ends in a series of abrupt changes. First the back legs sprout. Two or three days later the tail is absorbed, the front legs develop, and simultaneously the color of the tadpole changes from a uniform blue-brown to the characteristic mahogany with blotches of bright green.

The new frog, not much more than a quarter of an inch long from snout to tail root, is a big-headed, frail duplicate of its parents, extremely sensitive to sunlight and to "drying out." It is now in the most vulnerable period of its life; its only chance for survival is under the fallen leaves and decaying vegetable matter below the ape plant nursery. Here it seeks shelter from the elements and carnivorous insects, here it feeds on the minute animal life that thrives in the wet, loose substrate. When it emerges six to eight weeks later, it is half-grown and ready to begin the feeding activities of an adult frog.

Many parts of the *auratus* life cycle are still unknown, or can only be inferred. The most obvious of these unknowns concerns the newly emergent frog's life on the ground. How does it feed? How does it move about? What are its specific enemies? The grown frog's use of the ape cup for a nursery also brings up an environmental question. The ape plant and this frog species have overlapping ranges in Central America. Does *D. auratus* utilize elephant ear cups in the same fashion back in its home range? Or did it learn to do this in Hawaii, thereby increasing its chances for survival?

The colorful little frogs have not spread through enough of Hawaii yet to prove that they could help control farm insect pests. However, they have reproduced well enough to provide another benefit. It had been complicated and costly for American zoos to obtain them from Central America. But as long ago as 1957, New York City's Bronx Zoo began receiving them easily and cheaply by airmail from Hawaii.

Elephant Work

A traveler's account of the gainful

Except for sacred cows, probably no animal has influenced life in India in so many ways as has the elephant. Still wild in some of India's forests, it is a status symbol among Indians wealthy enough to own any, and it is almost as vital to the Indian lumber industry as the internal combustion engine.

Hindus represent Ganesa, god of wisdom and remover of obstacles, with an elephant head. And on all principal Indian feasts gaily caparisoned elephants carry temple idols in elaborate processions. In South India, such processions serve as occasions for temples to display their wealth, which is often measured by the number of pipers and drummers, the value and beauty of temple jewels, and the number and trappings of the elephants. Indeed, if a village can afford to, it may even rent a train of elephants for an important event.

In the hills of southwest Madras and eastern Kerala, a tremendous timber cutting and reforestation project is currently in progress. So-called blocks, sometimes comprising thousands of acres, are leased to private lumber contractors who bring in their own labor and equipment. Literally hundreds of Indians work in these operations: cutting, hauling, and loading the enormous logs, which are taken from a wide variety of trees. The essential job of the elephants is to move the cut timber to loading areas from where it can be trucked out.

I think the days my wife and I spent here were among the most enjoyable of our entire trip through South India. Amid splendid mountains and towering trees, some well over a hundred and fifty feet high and six feet in diameter, crawling trucks hauled the logs over roads so bad they seemed impassable. Over everything—forest. people, trucks, camps, and elephants—drifted clouds of white dust. But most impressive always were the working elephants. Near Parambikulam these belonged to private contractors; we found out later that those owned by the state of Madras were far better cared for and in much better condition.

One morning, as we made our way up the side of a steep hill just outside Parambikulam, we heard a high-pitched shout. "Elephants! Elephants!" Practically everybody in camp dashed over to look as three cows and two big bulls slowly ambled out from behind a cluster of jutting rocks. Wild elephants were eliciting more than usual concern this morning, it seemed. Our guide, Mr. Iyer, explained: "Two nights ago a small group of men and women was coming home from a party. They were walking on a forest path when, not far from where we are this very moment, they met a bull elephant walking toward them. Two little dogs ran barking at the elephant; this made him mad and he went for one of them. This little fellow, scared by now, ran to his master for protection. Everyone scattered as fast as they could, but the elephant caught the dog's owner and killed him instantly by hurling him against a tree and then stamping on him."

The preventive maintenance provided for the elephants engaged in timbering operations in Kerala and Madras includes pedicures, periodic skin and dental care, and—naturally enough—regular baths.

in South India

employment of Elephas maximus

by W. GURNEE DYER

Elephant food is prepared with exacting care. The cards above each portion bear data on the animals' age, condition, and diet. The white powder is a mixture of salt and minerals. At right, a mahout feeds his elephant a ball of food, which is composed mostly of dhal and grain.

He ended his explanation with considerable gravity, gazing fiercely at the bulls: "Now we may have a rogue to deal with."

It was finally decided that neither of the two bulls was the one they were looking for, and the two of them loped unconcernedly back into the bush, followed by the cows. Three of the boys in our party, however, convinced I ought to have a picture, gleefully started after them and motioned me to follow. I had neither the time nor the wisdom to refuse. Up hill and down we ran, through tangled vines and over rocks and fallen logs. By the time we got within shooting range I was indelibly impressed with the elephants' speed and agility.

Day after day, on this part of our trip, jeeps took us into the hills; sometimes Chief Forest Officer Sivaranakrishna of Kerala—the most talkative man I have ever met—accompanied us. Once he took us to a ten-year-old teak planting. As older, less valuable trees are harvested, teak is planted throughout the region. Seedlings are started in nurseries and subsequently planted eight feet apart in the cleared areas. These new stands get thinned at least four times before the trees reach maturity; a healthy tree ultimately requires some sixty square feet of living space. In sixty or seventy years, lumbermen return to harvest the crop.

At this plantation, an experimental patch of Japanese mint (*Mentha arvensis piperacens*) grew vigorously under the young teak trees. The plant—from which menthol is derived—is a low creeping annual with bright green leaves. Nearby, a small and primitive distilling plant had just been put into operation. As we were about to leave, the young, enthusiastic boy in charge gave us a tiny flask full of the oil. It was strong stuff, much stronger than any alcohol I had ever smelled.

Later in the day, near Parambikulam village, we were temporarily sidetracked, chasing the elephant they all said was the "killer." The whole town turned out to yell, run pell-mell for him, then throw stones and beat a hasty retreat. What they hoped to do was a mystery, as no one had a gun. The bull walked off a short distance before they all gave up and returned to whatever they had been doing.

Midday signaled time out for lunch in the logging camps. We ate with the foremen and contractor's agents. Their food was delicious, and we tried to remember Hindu manners as we ate, without utensils, on plates made of leaves. Hundreds of curious workers gathered at the doorway to watch us and comment discreetly to each other.

Soon we were outside again clambering over fallen logs and branches to where elephants pushed and pulled as the mahouts, perched comfortably on their necks, gave their mounts commands that were almost invisible to an observer. Two men always worked with an elephant and its mahout, tying thick ropes through the holes that had been cut in the end of each log. Then they held out the ropes for the animal to grab with its trunk, teeth, and tusks. With oversized timbers, two teams often worked together.

One morning, before daybreak, we left Parambikulam with Range Officer Panniker of Kerala, and drove to Topsil some eighteen hilly miles to the east. Here, Madras Range Officer Nair was waiting, so off we went with him on a mountainous run to the little village of Varagala Ar (*ar* means river in Tamil). Rugged vehicles are an absolute necessity on all these forest roads and even our jeeps had rough going over the difficult sections. At Varagala Ar the elephants are owned by the government of Madras and cared for like thoroughbred race horses. Perhaps twenty elephants were having their bath in the river when we arrived; this happens every morning and evening, before and after work. Then they are taken to a "paddock" to be completely inspected. Their feet are washed with a stream of water under high pressure from a hand-operated pump, and then oiled. Scratches, cuts, and bruises are treated; finally, each is tied to his special place and fed. Huge, dark-brown balls of food, about the size of a man's head, are poked deep inside the elephants' mouths. They seem to love this food and wait patiently, swaying to and fro with upraised trunks, until a mahout arrives with a new supply. At the center of the paddock, great steaming pots of elephant food are cooked. Along the wall, away from the heat and smoke, narrow tables hold rows of black, square blocks on which sit little piles of white minerals. Above each is a card bearing an elephant's name and an abundance of data about its age and condition. Nair told me, "The ball you've already seen being fed are made of rice, raggee [millet], and other pulses like dhal, to which w

The primary function of the timber elephant is to move logs to loading areas from where they can be trucked out. The strain of work is evident in the stance of the elephant above. Occasionally, as below, teamwork prevails.

add pinches of salt and various minerals. Each weighs a kilo, and a working or growing animal gets four or five daily. Elephants never actually work more than four hours but sometimes they have to go long distances to and from the logging sites, so the day can, indeed, be a long and rigorous one.

"These elephants," Officer Nair explained, warming to his subject, "are very valuable to us in our work here in the forest; they are better than lorries in many ways. They don't need spare parts, they don't need roads to reach remote places, and lorries can't produce little lorries; but tame elephants can and sometimes do have little elephants." He added, "When they have young we give the mother a five- or six-month rest, not because she requires it but to keep her calf out of the way of the older ones when they work. Most of ours are caught when young, but we have not needed any new ones this year."

At birth calves stand some three feet high and have a short, rather stiff trunk not more than a foot long. Females drop their calves usually from September to November after a gestation period of about twenty months, although, as Officer Nair had implied, elephants rarely reproduce in captivity. The young are weaned when they are approximately six months old and then become completely herbivorous. Most Indian elephants do not reach sexual maturity until they are about twenty-five years old, and the life-span of captive elephants is said to average about a hundred years.

Indians speak of three classes of elephants and grade them according to size. First comes the Koomeriah, especially large and well developed; then at the opposite end of the scale, the Mirga, which is badly proportioned, leggy, and weak. In the middle is the Dwasala, just average in size and weight—obviously the type most often seen in the camps.

Walking toward the training area, the range officer explained how wild elephants are trapped. Pits about twelve feet deep are dug and filled with leaves to a depth of four or five feet. When a young bull or cow walks over the camouflaged hole it tumbles in and cannot climb out. With the aid of older, trained elephants, and using a ramp that has been filled in at one end of the pit, men with ropes bring the captive out of its trap and escort it to camp. If, as often happens, inadvertent prey is taken—an elephant too old to train or perhaps a different species altogether—it is released.

Training is accomplished in stockades and must be sensitively done, to avoid ruining the elephant. The training period lasts upward of six months, although some elephants learn more quickly. Young animals are preferred trainees, of course. They not only learn faster but they live longer and thus render more years of work.

At that moment, I saw a young cow being put into the training stockade—much against her will, it seemed. She had to be hauled into the cagelike structure with a great rope around her neck while an enormous old bull literally fork-lifted her from the rear through the stockade door. Inside she grew quite calm as the mahout astride her neck put her through her paces, rewarding her with sugar cane as she obeyed each command. Behind the stockade's massive timbers a young bull underwent more advanced training in log shifting and in getting about tangled undergrowth and fallen trees.

That evening we sat talking with forest rangers and inevitably got around to elephant stories. A range officer said, "You know in many ways they differ from other four-footed animals. Babies nurse by sucking with their mouths as do other young, but the mother's teats are not where they are in cattle or horses. They're up under her arm pits."

Another added, "There are all sorts of opinions on elephants' intelligence, but those who think them stupid forget the cunning of 'rogues,' and you can't teach an animal without intelligence all the things our elephants learn. Besides, it is well known that if one gets on swampy ground it gathers anything nearby under its front legs so it won't sink. There's nothing stupid about that."

We all murmured a polite assent, and then the first officer told us about the *musths*. It is common knowledge among handlers that male elephants have periodic fits of madness and that they are extremely obstreperous and dangerous at these times. A male in such a condition is called a *musth* elephant. Liquid supposedly oozes from tiny holes on each side of the head near the temple when such a paroxysm is in the offing and is regarded by handlers as a warning. The fits, as described, sounded analogous to the rutting of male deer and are probably also related to sexual impulses.

The first officer proceeded to catalogue what he considered to be the most salient facts on elephant anatomy and behavior. Fortunately, tea arrived as he began, so we found ourselves more comfortable than we might have expected.

On the bottom of thick, straight legs are pads of five toes all joined together. Usually, four of the toes on the hind feet have toenails, although this can also be true of forefeet at times; the latter are almost perfectly round and larger than the hindfeet. Elephants cannot run but can move along at a brisk pace, nevertheless. (Here he stood up and demonstrated the gait—very effectively, I might add.) They are also incapable of any jumping action—because of their massive weight and the musculature and articulation of the leg—and so cannot cross openings in the ground six inches wider than their stride; for a large individual, however, this might be some six and a half feet.

The second officer shifted his weight, leaned over, and poured himself another cup of Darjeeling tea.

The sounds that elephants make seem to denote alarm, discontent, or pleasure. In addition to its trumpeting, the elephant gives an alarm by emitting strong blowing noises through its trunk and by thumping it on the ground. When it appears to be disgruntled or upset it makes deep, throaty rumbles. But high-pitched squeaks and squeals emerge after a gastronomic treat.

Elephants have a well-developed sense of smell and a delicate sense of touch, especially at the tip of the trunk. Stories in the timber camps, the first officer averred, also assign to elephants something of an emotional delicacy. For example, the animals cry copiously when they are moved to an altogether strange environment or when a mahout has left them. The attachment they form to their mahouts is strong indeed.

There are no teeth in the front part of their mouths except for two incisors, which are difficult to see in young elephants and adult females. Males, or tuskers as they are called, have ivory incisors, which grow throughout life and which have been known to reach a length of more than eight feet.

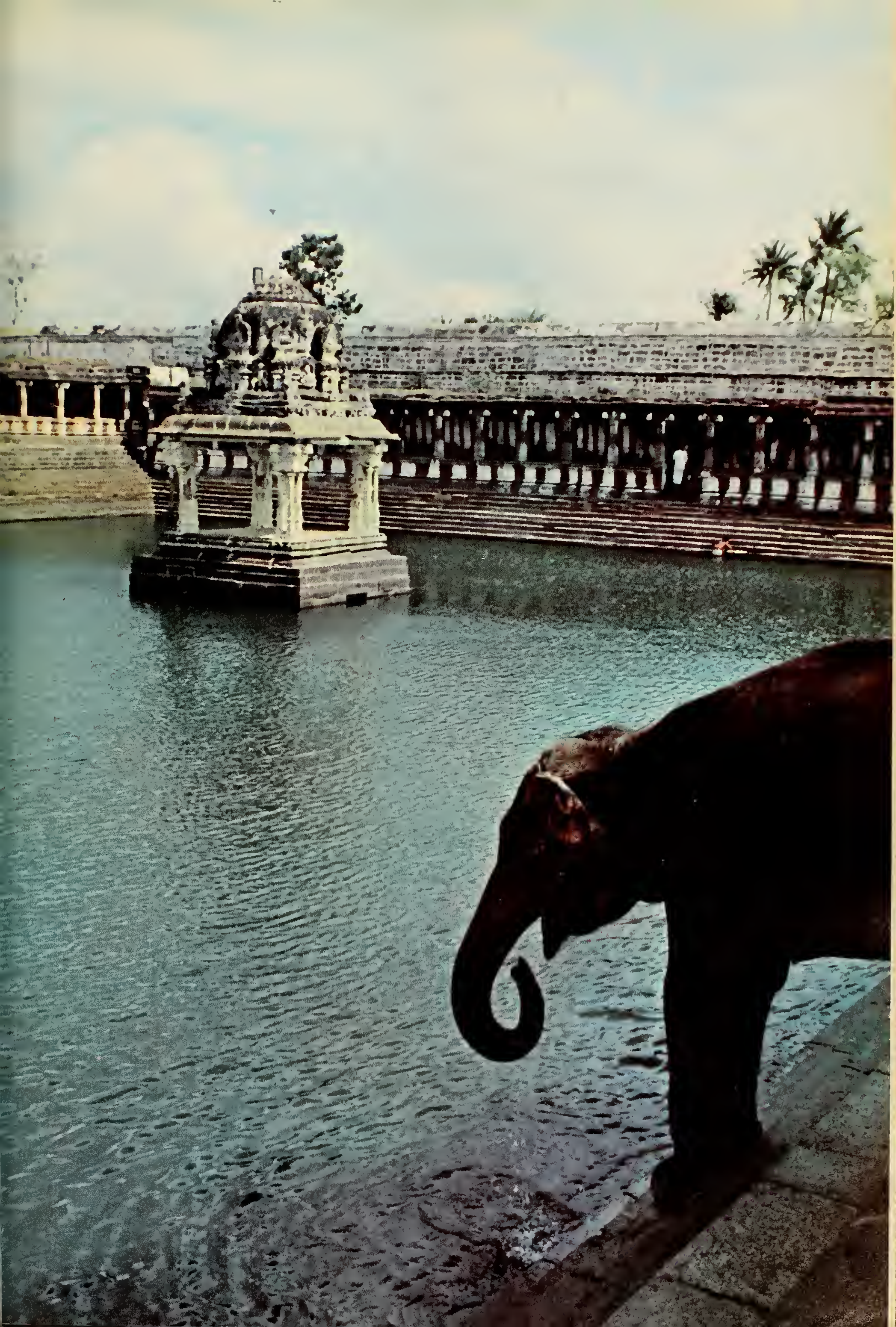
The second officer added that King George V had possessed a pair of elephant tusks that measured eight feet nine inches in length and weighed one hundred sixty pounds.

The first officer continued. To grind up the mass of fodder an elephant consumes—from six to seven hundred pounds per day—an adult has six long molars on each side of the upper and lower jaws; these continue to grow throughout its life. Only four functional molars are exposed at one time—the front molars on each side of the upper and lower jaws. As they wear down, new ones move from the rear to the front, replacing those that are badly worn.

The rest of the evening we heard stories about the memories of elephants—most of them highly exaggerated, we thought. But trainers, mahouts, and range officers still claim that there is a sound basis for much that has been told.

In another city weeks later, an Indian who had spent many years with elephants showed us an ancien book, long out of print. One quotation, from a writer who lived centuries ago, had this to say: "He tha hurteth them must take heed, for they never forget when any man doth them injuries until they be avenged."

Many domesticated Indian elephants lead lives that are less rigorou than those of the timber elephants. This one—whose main work consist of carrying portable shrines in religious processions—is th private property of the temple in whose pool it freely drinks



Color Through A Raindrop

The mechanics of rainbow formation

by
Richard E. Orville
and
William C. Livingston

The basic ingredients of a rainbow are well known—rain and sunshine. But to understand the rainbow's appearance, it is necessary to follow the path of a light ray through a raindrop.

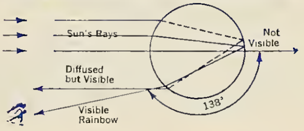
White sunlight enters the raindrop at many places on its surface. Depending upon where the rays enter, they are refracted into all the colors of the spectrum, reflected at different points on the inside surface of the drop, and again refracted as they emerge from the droplet in various directions. The necessary amount of deviation (measured between the light rays' paths of entry and exit) undergone by light rays in order to form a visible rainbow is 138 degrees. Violet light is deviated slightly more than this, and red slightly less, because short waves of light (violet) are bent, or refracted, more than ong waves (red).

At an angle of 138 degrees (the 'angle of minimum deviation") sunight undergoes maximum dispersion nto the separate colors of the specrum, and in addition, will emerge rom the water drop with the greatest ossible concentration, so that the olors can be seen as a rainbow. The resence of many raindrops refractng and reflecting the sun's light back o the viewer creates a sharp visible pectrum, with the color red at its pper edge and violet on its underide. Light rays that are deviated nuch less than 138 degrees will pass n through the drop and will not be bserved (*see diagram*). Rays that re deviated much more will be cattered back toward the viewer as isible, but diffused, white light.

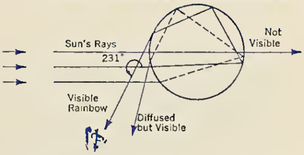
Occasionally, both primary and econdary rainbows can be seen. The ngle of deviation required to form visible secondary rainbow is 231 egrees, resulting from the light ays' point of entry and the fact that ach of these rays undergoes two inrnal reflections before emerging om the drop. Since only a small umber of rays experience this doule reflection, the secondary bow is mmer than the primary.

It is convenient to think of the inbow arcs as forming concentric rcles whose center is somewhere low the horizon. The extension of an imaginary line drawn from the sun to the observer's eye passes through the center of these imaginary circles, or the antisolar point. Thus, if the sun is high enough in the sky, as at noontime, the antisolar point is necessarily depressed far below the horizon and the rainbow will not be visible. Because of the unique angular deviation of light rays necessary to produce visible rainbows, the angle between the imaginary line and the line from the observer to the arc of the rainbow will always be 42 degrees for the primary bow and 51 degrees for the secondary bow.

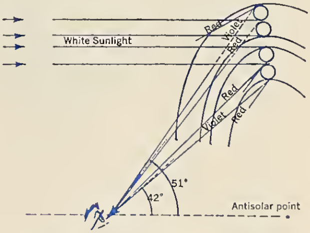
Single Internal Reflection



Double Internal Reflection



Sunlight emerging from a raindrop may appear to a viewer as a visible rainbow, as diffused white light, or may pass through the drop, unseen.



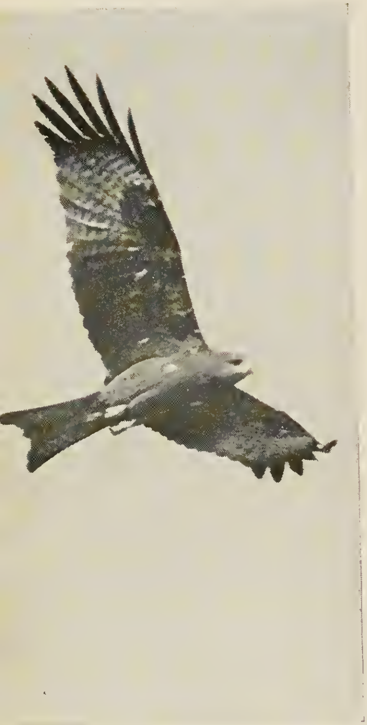
The raindrops' position, and their refraction and reflection of light, account for the colors a viewer sees.

If visible, the secondary rainbow appears outside of the primary bow because of the great deviation of its rays. Again, the blue rays will be deviated slightly more than 231 degrees while red rays will be bent slightly less. However, red will be seen at the inner edge of a secondary rainbow and blue at the outer fringe. As shown in the diagram, the visible rays of the secondary bow enter the bottoms of water droplets and undergo double internal reflection, which reverses the order of the colors seen in the primary bow.

A more subtle observation is that the region between the two rainbows is darker than the regions inside the primary bow and outside the secondary bow. This is due to the action of light rays entering water droplets in these regions. On the inside of the primary bow, once-reflected light rays that are deviated more than 138 degrees are the only rays that can reach an observer. Although these rays are not sufficiently concentrated to produce a visible spectrum, they provide a diffused. white light that reaches the viewer and "lights up" the area inside the bow. Similarly, rays that are doubly reflected and that undergo more than 231 degrees of deviation illuminate the region outside the secondary bow. In contrast, the region between the bows does not reflect light to the viewer and appears relatively dark.

A rainbow is a product only of the proper angular relationships between the sun, the raindrops, and the observer. Despite the bow's "flat" appearance, storm droplets at the proper angle from the viewer back up one another to give the bow a dimension of depth. This depth will make the rainbow colors brighter or dimmer, but of course, cannot be observed directly. If a viewer walks toward a rainbow, he may pass the position of the raindrops that first diverted the spectrum to his eye, but he will not be able to look up and see the rainbow over his head. He may still see a rainbow in the distance, but this will be a new arc formed at the appropriate angle from his new position.

Thus, chasing rainbows unfortunately does not bring us any closer to them. And for this reason, it still remains impossible to verify the existence of the proverbial pot of gold at the rainbow's end.



The Black Kite (left) is currently maintaining or increasing its population, while the Red Kite (below) is declining over most of its range.

Red Kites circle the mountain grasslands of central Wales, where fewer than sixty birds remain of a population once widespread in Great Britain.

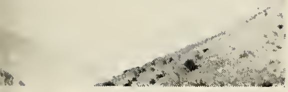
The Kites of Europe

The Red and Black Kites illustrate the varying fortunes of the world's birds of prey

BY WILLIAM CONDRY

Today, because of ever increasing human pressure, the future of many of the world's birds of prey is in jeopardy. The assault against them may be unintentional—for example, by the destruction of woodland, marshland, or other habitats, or by the massive use of poisonous insecticides. Or it may be direct. Birds of prey are destroyed to protect domestic animals and poultry or, as during every shooting season in parts of southern Europe, many are sho down by "sportsmen." Europe, wit 39 diurnal birds of prey on its lis may seem rich in predatory bird but in reality a large number o these are local, marginal, or rar species. Except for a few districts o the extreme southeast and southwe the skies of Europe are noticeabl lacking in birds of prey.

The status of two closely relate European species, the Red Kit



ilvus milvus, and the Black Kite,
ilvus migrans, seems especially
orthy of attention not only because
ey illustrate the varying fortunes
many other birds of prey but be-
use these particular birds have en-
yed a peculiarly intimate rela-
nship with man. These true kites
long to a large, worldwide family,
e Accipitridae, which includes such
verse species as the African Fish
gle; the European White-tailed
gle; the American Bald Eagle; the
red Brahminy Kite, or Red-
cked Sea Eagle, of India; the
erglade Kite of Florida; the Mis-
sippi Kite; and several others.

A glance at the distribution map
ws that Europe is only a small
rt of the Black, or Pariah, Kite's
rld range, for the species is found
across Asia to Japan. It is also
nmon in most of Africa and oc-
ies the northern half of Australia.
its specific name *migrans* sug-
ts, it is migratory in many parts
ts range and, being highly gregar-
s, it performs spectacular mass
vements at the passage seasons.
outstanding characteristic, which
kes it, along with the Red Kite,
usual among birds of prey, is the
lessness it displays toward man.
ecially in India and parts of
ica it is notoriously bold, forag-
in and around towns, ports, and
ges where it makes quick swoops
natch up food from market stalls
and even from baskets carried on people's heads. This highly developed opportunism is no doubt a result of its manner of hunting in more natural habitats where it patrols at no great height, rather in the style of a harrier. It surprises small prey by a lightning swoop and grab with its talons, which are not at all massive, but which are strong and wiry. Why the Red and Black Kites have become so familiar with man, while other hawks have not, is presumably due to their pre-eminence as "a snapper-up of unconsidered trifles [as Shakespeare described the Red Kite]," combined with an ability to digest a wide range of discarded rubbish. Being partial to the vicinity of water, the Black Kite perhaps became an intimate associate of primitive man at the African lakeside villages of the most remote prehistory. There it may have learned to pick up rejected fish and offal just as it does today. Although its thieving habits have tried the patience of man in four continents, its value to human hygiene has long been recognized, and it has been widely tolerated. It is only in comparatively recent times, when man has begun to undertake responsibility for the sanitation of his communities, that the Black Kite is no longer needed to dispose of carrion in such areas as Europe and South Africa. Yet even around many modern towns, such as Lucerne in Switzerland, Black Kites are still familiar lakeside birds on the edges of the built-up areas.

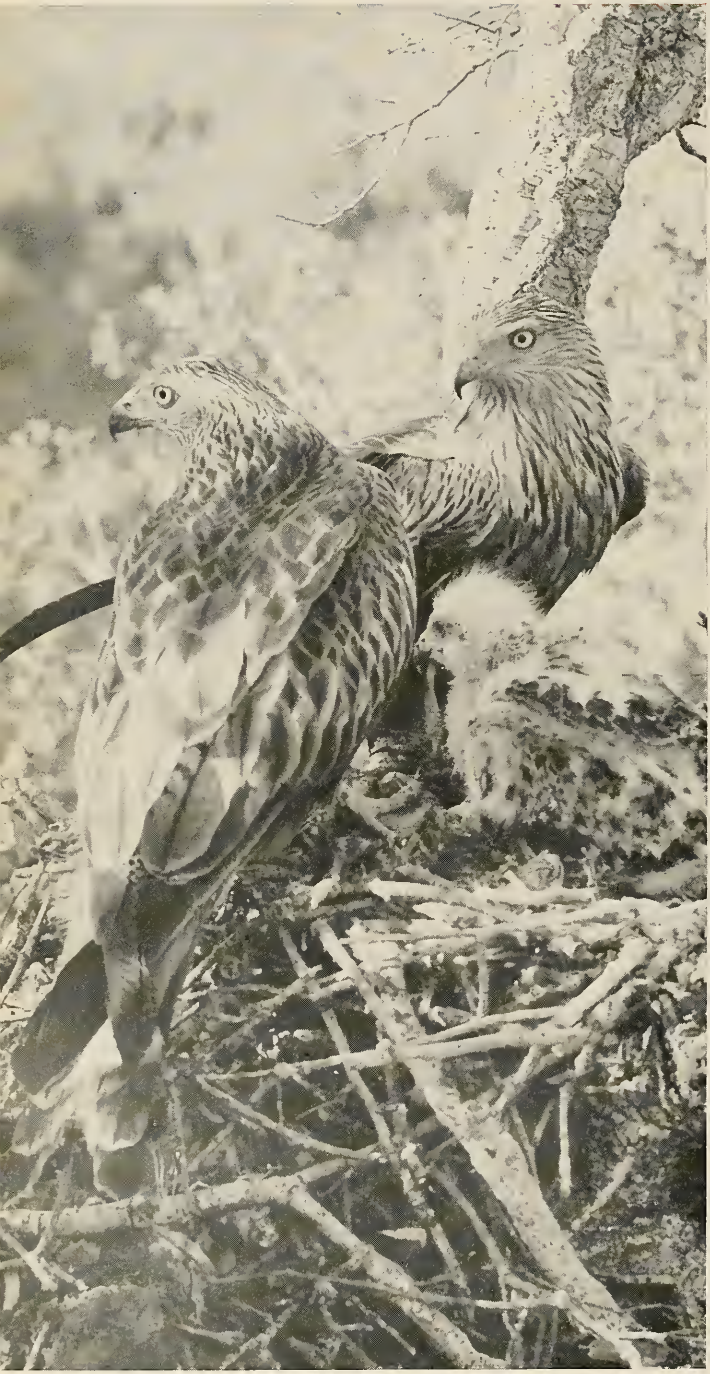
Although it is a scavenger apparently dependent on the proximity of man, the Black Kite can be totally independent, for it is a resourceful hunter of living prey, taking small birds and mammals, fish, frogs, lizards, snakes, and other creatures. It is sometimes attracted in large numbers by plagues of rodents and swarms of insects such as locusts, and is one of the leading African bush fire opportunists—those birds that hover above the advancing flames and snap up insects trying to escape from the fire. Of course, it also gathers with vultures and Marabou Storks at the carcasses of animals rotting on the plains of East Africa. When we learn that it will even eat the nuts of the oil palm, we begin to appreciate the species' adaptive advantages. It has learned to forage in almost every principal type of land habitat in its vast range except in tropical rain forest.

Gregarious whether migrating, feeding, or roosting, the Black Kite also tends to breed communally. Its nesting pattern is not like that of rooks or herons, which cluster in one tree; rather, nests are spaced out over a stretch of woodland so that each pair is relatively isolated. Three eggs form the average Black Kite's clutch and—what is more significant—three young are often successfully reared. There is another important adjunct in the survival of this kite, besides its evident ability to breed and forage. If clutches of eggs are destroyed, it usually lays again; this is unusual in most birds of prey.

Kites may live a long time. There is one instance of a kite banded in central Europe that was recovered more than twenty-five years later. This longevity, plus high fertility, adaptability, opportunism, and the absence of excessive persecution in many areas of its range, explains why the Black Kite is one of the few birds of prey currently holding its own, perhaps even locally extending its range in Europe.

The success of the Black Kite appears the more striking when we consider the fortunes of its cousin, the Red Kite. Both are large, long-winged, buoyantly gliding hawks, distinguished from all others in Europe by their long forked tails. Both fly low when hunting and drop with a quick swoop on a wide variety of small food items. Both have learned to exploit man's proximity.

Although somewhat larger and presumably stronger than the Black Kite, the Red Kite is steadily declining almost everywhere, and in Europe it is now far outnumbered by the Black Kite. A proportion of twenty to one has been suggested even for southern Spain, where there are more Red Kites than in most European countries. Formerly widespread and common in western Europe, the Red Kite has been exterminated in most of Britain and, more recently, in Denmark and Norway, although it has made a slight attempt to return to Denmark in re-



cent years. In Sweden it has become rare, and in many other countries it is losing ground. In Britain a precariously small relict population holds on in central Wales. Other isolated populations exist in fair but locally decreasing numbers on the Atlantic islands of Madeira, the Canaries, and Cape Verde.

With two closely similar species living sometimes side by side, one naturally wonders about interspecific rivalry. But if this rivalry does exist it is not connected with the Red Kite's decline, which is simply the result of having been far more persecuted than the Black Kite. This, in turn, is presumably due, in part, to the difference in habitat preferences of the two species. For the Red Kite is more pronouncedly a bird of farmland and woodland where it has come into more frequent conflict with gamekeepers. Always circling over fields and forests, it has inevitably become an object of deep suspicion among the protectors of pheasants and partridges. Near farms the Red Kite has been convicted of chicken stealing far more often than its black cousin. Paramount in the Black Kite's greater freedom from persecution is that, being more of an insect eater, it canno winter in most of Europe and so spends half of every year in the comparative safety of Central Africa In contrast, the Red Kite, wintering in Europe and often faced with food shortages, is inevitably more tempted to attack poultry. An easy bird to trap, the Red Kite has also undoubtedly been made the scapegoa for depredations that actually wer caused by a whole galaxy of othe poultry yard predators.

Man's hand was not alway against the Red Kite. In the Middl Ages it was as familiar a scavenge in some of the towns of Europe a the Black Kite now is in the Tropics

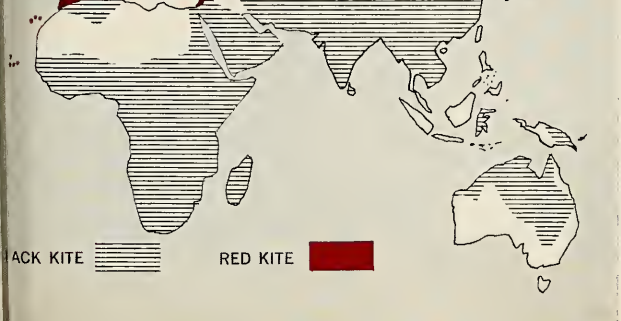
In Wales, Red Kites formerly reared a many as three young each year, but th average size of the clutch has decline since the early years of the century. I its eggs or young are destroyed, the Re Kite, Milvus milvus, *rarely replaces th clutch during the same nesting seaso*

Black Kites generally raise three young. This adaptive species, Milvus migrans, *will usually lay again if the first clutch of eggs is destroyed.*

d was protected locally by law in cognition of its services. It is pos-ble that in those times the Red Kite s more of a town bird in north d west Europe than the Black Kite er was. The Red Kite's presence London is attested by several con-mporary commentators. In 1465 secretary to a Bohemian noble-n visiting England wrote that he d never seen so many kites as on ndon Bridge, and that it was an ense to kill them. In 1496 another itor, the secretary to the Venetian bassador, remarked on the boldness of the London kites, which he saw snatching bread and butter out of children's hands. He, too, mentions that there was a penalty for killing the birds because, together with ravens, they kept the streets of the town free from all filth.

It is sometimes questioned whether these kites of medieval London really were Red, and not Black, Kites, but there seems to be little room for such speculation. Almost as if he foresaw people's later doubts the English herbalist William Turner (1515-68), in his *Spirituall Physic,* having well described the Red Kite and its habits added: "the other kind, smaller, blacker and more seldom seen in cities I do not remember ever to have seen in England though very frequently in Germany." Turner also wrote in a letter to Conrad Gesner, the German naturalist: "We have kites in England the like of which I have seen nowhere else. Our birds are much larger than the German birds [by which he meant Black Kites] more glamorous, tending more to whiteness and much greedier. For such is the audacity of our kites that they dare to snatch bread from children, fish from women, and handkerchiefs from off hedges and out of men's hands. They are accustomed to carry off caps from men's heads when they are building their nests."

By the seventeenth century the status of the Red Kite in Britain and on the Continent had changed from that of a protected bird to that of a pest. In English churchwardens'



The Red Kite is primarily confined to Europe while the Black Kite's range includes most of Europe, Africa, Asia, and the northern half of Australia.

accounts we find frequent records of payments for kite destruction. At Tenterden in Kent, for instance, bounties were paid for 318 kites killed between 1677 and 1691. "Kites" in this context can be taken to include the Common Buzzard, *Buteo buteo*, for the names of the two species were often confused. As these subsidies for the destruction of kites continued to be paid in most of Britain, the populations of these birds inevitably began to shrink. Before the end of the eighteenth century the kite had probably ceased to breed in London, but it evidently continued a little longer on the outskirts of other British towns, for Montagu in his *Ornithological Dictionary* (1802) said that it "frequently resorts to the environs of towns to feed on offal." This is about the last glimpse we have of the Red Kite as a town-fringe bird.

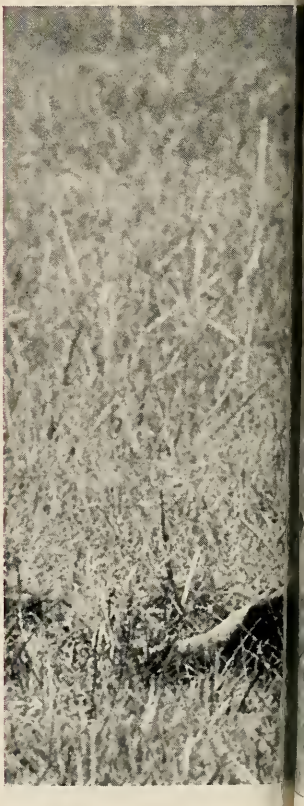
By this time, shooting for sport and gamekeeping were becoming organized. Gamekeepers, who were evaluated on the basis of the number of vermin they destroyed, were widely employed throughout the rural lowlands of Britain and consequently kites soon became rare. In the 1830's the war of extermination was carried to the mountain country, where grouse shooting had become popular. On one Scottish Highlands estate the destroyed vermin totaled several thousand mammals and birds in four years; this included 27 White-tailed Eagles, 15 Golden Eagles, 18 Ospreys, 98 Peregrines, 63 goshawks, 659 buzzards, 462 Kestrels, 83 Hen Harriers, and 275 Red Kites.

By 1865 A. G. More, summing up the position in England, wrote: "The kite has become so scarce that it is impossible to distinguish between the districts where it is quite extinct and those where a few pairs may still continue to breed." After 1870 all that remained of this formerly common species were two relict fragments, one in central Scotland and the other 300 miles away in central Wales, two of the wildest areas of Britain. Too few for gamekeepers to bother with, the Red Kite now had high rarity value and so came under attack from collectors of eggs and skins. How they finished off the kite in Scotland was fully documented by the collectors themselves, men like E. T. Booth who, in his book *Rough Notes on the Birds Observed During Twenty Years Shooting and Collecting in the British Islands*, describes how he waited by kites' nests and shot both parents on arrival. Not surprisingly kites probably ceased breeding in Scotland before 1890.

In Wales, from the late 1880's onward, the collectors found themselves opposed by a small but determined group of people who considered that so rare a bird as the Red Kite should be given a chance of survival. A successful appeal was made for the help of local landowners, and since some of these proprietors were influential over a wide area their support was invaluable. At least one of them actually employed his keepers to guard kites' nests night and day, which was a strange reversal of a keeper's normal function. Meanwhile some of the leading British ornithologists were beginning to speak up for kite protection. But since the ornithologists of that generation were nearly all egg-collectors, they had to surmount the difficult task of disciplining not only themselves but also their fellow collectors. In 1910 a leading British ornithologist, H. F. Witherby, lamented the time and money spent "in protecting ornithology from ornithologists. The collecting of 'British taken' eggs is a mania and it can be called nothing else."

That difficult period was abruptly terminated by World War I, which diverted attention elsewhere. For many dwindling predators the war was a real lifesaver because, when it ended, gamekeeping was never resumed on anything like the pre-war scale. In Wales, the buzzard and the raven, which had become almost as rare as the kite, then increased to become the common birds they are today. Although the Red Kite made no such spectacular recovery, its numbers stopped declining and might have improved markedly if the collectors had not persisted. As it was, the population, perhaps 12 in 1900, was still not more than about 20 by the 1930's. By that time the old method of guarding nests proved too costly and too ineffective, and had been replaced by the payment of bounties to owners or tenants of woodland where Red Kites nested successfully. This method is still being followed. During recent years the Red Kite has been increasing gradually, but not without frequen setbacks. Following more than usually successful seasons in 1965 and 1966, when 12 and 10 young were reared respectively, the present population, including a scattering o non-breeding birds, has increased t between 50 and 55 individuals.

But the rate of increase is still extremely slow. Early in this centur the existing pairs occasionally raise three young in a season; no know Welsh kites have done so for man years. In addition, in marked con



The Black Kite's diet includes carrion and discarded rubbish, as well as insects, nuts, and a selection of small mammals, birds, fish, frogs, and snakes.

rast with the Black Kite, Red Kites arely replace lost clutches. The roblem of lowered fertility has long vorried the Welsh kite's protectors, nd attempts have been made in the ast (with scant success) to introluce eggs and young of Red Kites rom Spain. When released, the oung have apparently wandered off rom Wales, presumably toward Spain, and it is doubtful if the eggs vere ever successfully hatched.

Looking for possible causes of ow fertility in Welsh kites one soon neets the much repeated suggestion hat it is due to inbreeding, but there s no way of proving that this is so. There is also a possibility that the ood supply is inadequate, but here gain there is no evidence. In the ast few years traces of a poisonous nsecticide sheep-dip containing diellrin have been found in the bodies and eggs of Welsh kites, which evidently ingested it along with carrion mutton or wool. Dieldrin is now officially banned in Britain, but one waits with trepidation to see what new chemical hazard will next threaten the birds of prey.

It is probable that other dangers will arise in Wales. Every year sees the mountain grasslands—the kites' chief foraging ground—more and more invaded by coniferous afforestation. There is also a current movement to turn central Wales into a national recreation area, a development that might well lead to increased disturbance of the kites at nesting time.

In view of the modest success of the kite in Wales, one may wonder whether something could be done to save the dwindling Red Kites of continental Europe. In theory this would be possible. But it must be remembered that a vast amount of time and money has been devoted to that small colony of Welsh kites. People have learned over the years, as the result of education, to take a generous and personal interest in the welfare of the kite and to pride themselves on being the guardians of a rare and beautiful species. It may well be that the cultivation of this attitude in key localities in other parts of the world will be necessary to save many of our threatened birds of prey. As experience in Wales has shown, it is a slow but rewarding process. Lately there has come a gleam of hope from the extreme south of Spain where a nature reserve has been created by the Spanish government on the Coto Doñana, an area rich in wildlife, including both species of kite. One can only hope that this represents a real breakthrough and that an age of enlightenment in matters of bird-of-prey conservation may yet come to Europe in time to save the Red Kite and other magnificent species.

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A NATURALIST *continued from page 14*

most unsuccessful public lecture was before The New York Academy of Medicine some years ago. I proposed the formation of a "Society for the Prevention of Cruelty to Parasites." They didn't think it was a bit funny, though I still don't understand the ethics behind the decision as to which animals are to be nurtured, and which persecuted.

The widespread disapproval of anthropomorphism often puzzles me. The scientist who gets upset by "angry bees" will calmly write about a "field of knowledge." Language is built of metaphors, but they are apparently only safe when long usage has rendered them quite dead or when they are in no way open to possible misinterpretation. I think, however, that Joseph Wood Krutch had a point when he proposed, in his book *The Great Chain of Life*, that there was an equally dangerous sin in "mechanomorphism," which considers animal behavior to be machine-like. The latter sin is compounded by a resulting awkwardness in writing, but this never seems to bother scientists much. To be scientific in writing about Brunhilde, for instance, I should have noted that "a particular female of *Lampornis clemenciae* was observed to have a tendency to orient toward spots of brightly contrasting colors." Dull, but perfectly safe.

For me, the most dangerous sin of all in reporting on animal behavior —and perhaps the most common and insidious—is one that doesn't even have a name as far as I know. It is the sin of thinking that some other animal lives in the same sensory world we do. I spent many years studying the behavior of mosquitoes, and I dedicated the book that resulted, the *Natural History of Mosquitoes*, to my first chief, the late Lewis Wendell Hackett, "able exponent of the importance of trying to see the world from the point of view of the mosquito." I never did have much success at this: the sensory world of the mosquito was so different from mine that I could rarely be sure what factors initiated or controlled a particular pattern of behavior. As far as I know, for instance, we still don't understand what leads a mosquito to bite a particular animal, or how we affect this when we prevent the biting by smearing repellents on our skins.

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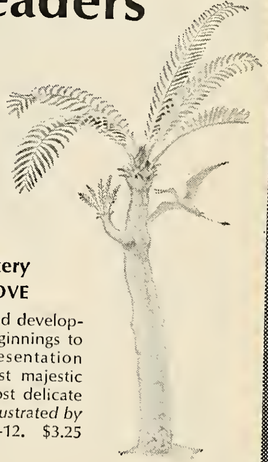

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With birds and mammals, the situation would seem to be easier because the sensory systems are for the most part related to our own. Yet birds are hard to understand: I have little feeling that I can know the hummingbird point of view toward the little world of my garden. The problem is stated nicely near the end of a book by Stuart Smith and Eric Hosking, *Birds Fighting*. "The really difficult part," they write, "is the interpretation of results once they have been obtained. How can one get behind the bird's eye and learn what is dictating the course of action observed? . . . For the world of a bird, though externally it may be the same world as that in which we live, may appear to that bird a vastly different place from ours."

I started out to write about aggression and territoriality among the animals in my experimental rain forest, and then got off on this digression about scientific sin. With the greenhouse, I think I have stumbled onto a technique that may be useful in many sorts of behavioral studies —something intermediate between caged laboratory experimentation and field observation. My animals are tropical species about whose habits in the wild little is known; but in the few cases where I can make comparisons, as in the instance of the Blue Honeycreeper (*Cyanerpes cyaneus*), carefully described by Alexander Skutch in his *Life Histories of Central American Birds*, behavior in the greenhouse seems remarkably similar to the behavior he observed in coffee plantations in Costa Rica.

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perimental area (which covers about 500 sq. ft.): hummingbirds (Trochilidae), honeycreepers and tanagers (Thraupidae), finches (Estrildidae), manakins (Pipridae), and sunbirds (Nectariniidae). Unfortunately there is only a single specimen or a pair of each species (except for two male Rivoli's Hummingbirds, *Eugenes fulgens*) because I am afraid of overcrowding. This makes it difficult to study "aggression" as defined by Lorenz—fighting among individuals of the same species. The two Rivolis seem to get along together well, which is unusual for hummingbirds. I have rarely seen them fighting; on the contrary, they often sit side by side on an electric wire in the evening, catching the fruit flies that fly toward the light.

There are seven species of hummingbirds in the system, however, and that gives me plenty of opportunity to watch fights. I have been trying to think of an appropriate adjective for these birds—aggressive, nasty-tempered, belligerent. Maybe belligerent is the best—closer to Lorenz's *böse* than the English "aggressive."

It would be difficult to prove that hummingbirds are the most belligerent of animals, but they would certainly rank high on any list. I have sometimes thought that they could afford to be nasty because they were so beautiful. (There is a scientific generalization for you!) More likely, they have been able to develop relative fearlessness because of their mastery of the air. Other birds can fly faster; the Brazilian expert Dr. Augusto Ruschi estimates the average speed of hummingbird flight at between five and thirty miles per hour, with thirty as about the maximum. But no bird can match the aerial acrobatics of hummers, which I imagine enables the adults to escape the usual hazards of predation, at least in the daytime.

It is too bad that most of the 319 known species of hummingbirds live in remote tropical American forests, while most students of animal behavior live in Europe or North America. Only one species, the Ruby-throat, reaches the eastern United States; eleven species have been found to breed in the western part of the country, but some of them only close to the Mexican border—these figures from Crawford Greenewalt's beautiful book, *Hummingbirds*.

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All observers agree about the belligerence of hummingbirds, but they do not fit Lorenz's concept of intraspecific aggression, because every individual seems to be at odds with every other at times, regardless of species or sex. Frank Pitelka summarized many of the early descriptions in an article in the issue of *The Condor* for September-October, 1942. In his own observations on Ruby-throats, he noted that they sometimes chased bees and hawk moths as well as other Ruby-throats (the only hummingbird species available). Buzzing flight may have been, at least in part, the stimulus for attack. In my greenhouse, any new hummingbird causes an uproar, with resulting fights that look very vicious, although I have never been able to detect direct physical injury. Fights continue sporadically, even when the birds have been living together for years. But the belligerence seems to be purely among the hummingbirds themselves—they ignore other birds, even the honeycreepers, which use the hummingbird feeders when perches are provided.

Belligerence among animals takes many forms. One is against possible predators. I have not been able to observe this, because I keep predators out of my system except for small lizards and frogs. But Dr. Ruschi in Brazil catches his birds by using a tame owl as a decoy in the forest: all of the local hummingbirds gang up to pester the owl, and Dr. Ruschi then catches them with a fishing pole that has a daub of linseed oil at its tip. The birds stick to the oil when they are touched. The wings are easily cleaned, and the captured bird can then be released in a huge, screened outdoor cage. (Brazil has some obvious advantages over Michigan as a place where one can keep captive hummers.)

Hummingbirds also fail to fit neatly into territorial classifications. My first two birds, Gould's Violet Ear Hummingbirds (*Colibri coruscans*), were released in the Orchid Room two years ago, and promptly named Gamon and Spinach with memories of the nursery rhyme. We thought they were a pair, although the sexes are practically identical in this species. After considerable squabbling, they divided the room almost exactly in half, forming two territories with frequent, vicious fights at

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he boundary line. Some visiting or-
iithologists were sure we had two
nales, but Spinach disproved this by
ouilding a slipshod nest in the top of
Dracaena and laying two eggs—
vhich presently fell through the bot-
om of the nest to break on the floor.

Hummingbirds are known to build
eat and sturdy nests, but they use
iaterials such as spider webs for
inding. But spiders don't have a
hance in the Orchid Room with the
oneycreepers constantly on the alert
or such tasty morsels. We have
rewn various sizes of tea-strainers
oout, hoping the birds would use
iem as bases for nest building. The
oneycreepers take to this, but Spin-
h has so far scorned such gadgets,
ough there are intermittent lulls in
r squabbles with Gamon, which I
tribute to sexual impulses.

Field evidence (summarized by
telka) indicates that humming-
rds are apt to set up a territory-like
fense of favored feeding areas. and
at females defend the nest area, but
ch arrangements are apt to be tem-
rary and shifting. It is interesting
at with my birds only the hummers
er pass through doors into strange
eas. Even when a door is propped
en for some reason, the other birds
stay at home. The greatest wan-
rer of all, however, is Brunhilde,
th whom I started this account. She
es everywhere except through the
ided curtain, gets into fights in the
irse of her wanderings, but still
ms to hold her own, or at least be
lifferent to status. Brunhilde is a
st remarkable bird.

We are trying to keep careful rec-
ls of events in this tropical garden
l to avoid the assorted sins of be-
ioral experiments and observa-
is. Several students are working
projects there, and maybe we will
ne up with some meaningful ideas.
it is also fun: not only with the
ds, but with the marmosets, liz-
s, frogs—even the insects. Cock-
ches, though, have ignored the
ded curtain and have moved all
ough the house, to the consterna-
of some of the human inhabi-
s. There are hazards in having a
gle directly south of the living
m door.

*ston Bates is a well-known author
also teaches biology at the Uni-
ity of Michigan. His column now
ears regularly in Natural History.*

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The nature of reality

by Colin M. Turnbull

The Savage Mind, by Claude Lévi-Strauss. *The University of Chicago Press, $5.95; 290 pp., illus.*

Any reader would be justified in expecting a book entitled *The Savage Mind* to deal, among other things, with totemism. Unfortunately there are many, particularly in the ranks of professional anthropology, who would expect the subject matter to be almost exclusively totemic; to them this might even mean exclusively the totemic system of the Australian aborigines, which, by virtue of being the most complex system known, is too often mistakenly thought to contain all that need be known about totemism. There is little in this book that will appeal to such tiny minds, and its true value will escape others who are similarly myopic. On the other hand, those who would be the first to proclaim themselves as disciples of the author of this remarkable book are equally likely to reap but partial benefit if they expect Claude Lévi-Strauss, genius of French anthropology, to be saying something unduly complicated simply because he is Claude Lévi-Strauss.

The author has the strange reputation of having reduced human society to mere mathematical equations, and of being abstract in his thought, as in his approach to anthropology, to the point where he can pursue his own thoughts only by means of computers. It is somehow never allowed to emerge that Lévi-Strauss is not an inhuman machine, but a warm, incredibly sensitive human being, with emotions just as powerful as those of anyone else. It might not be wrong to say that he is also a dedicated human being, and the object of his dedication is the true understanding of man. Perhaps he would, to be perverse, insist that the object of his devotion was society rather than man,
but this work shows a profound con-
cern for, and understanding of, man
the individual, just as it tells us about
man as a social particle.

This is not to say that *The Savage*
Mind is an easy book, for Lévi-Strauss
is not given to facile generalizations
As a true scientist he treats his sub
ject, and his readers, with respect. H
considers different points of view an
conflicting evidence, and support
every statement with fact. Any one o
us might find ourselves in possessio
of facts that would lead us to disagre
here and there with some of the conclu
sions drawn or with some of the inte
pretations given, yet the bulk of th
evidence is clear and unequivocal.

Lévi-Strauss is not likely to wish t
see himself as a knight in shinin
armor, and his devotees would be sti
more dismayed at such iconoclasticisn
Yet, consciously or otherwise, he ha
devoted his life to the shattering of o
ignorance concerning "savage man
a term that, with dry Gallic humo
he persists in using. *The Savage Mi*
continues the battle, undermining st
further the ground upon which tho
stand who would dismiss primiti
man simply because of the super
cial strangeness of his ways and a
parent difference between his mode
thought and ours. The book is, ho
ever, far more than an attempt to cle
up old misconceptions. It is an eloque
appeal for a positive approach, in whi
we are urged to look to primitive c
ture for a better understanding of ma
kind and of human society. It succee
in this in an unexpected way, for
will make the reader question
whole nature of social reality. To sh
usage of abstract terms in primit
languages, Lévi-Strauss cites a Chin
example: to render the statement "
bad man killed the poor girl,"
Chinook would say, rather, "the ma

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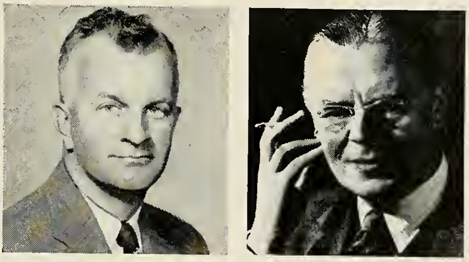

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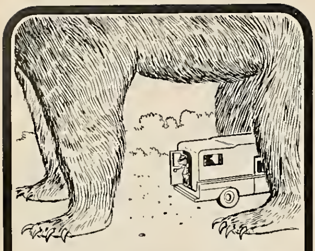
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badness killed the girl's poverty." This is interesting linguistically, but it is of even greater importance in terms of social philosophy, and one wonders whether the Chinook, or other primitive peoples who show similar discernment, do not have a better grasp of the essence of reality than we do.

With regard to the thought of primitive man, Lévi-Strauss points out that Neolithic man was already heir to a long tradition of scientific thought. Agriculture, the domestication of animals, pottery, weaving—all these things and more cannot have been arrived at by mere perception of natural phenomena, only by a logical mental process. The book proceeds to illustrate that process as it can be seen at work in divers aspects of primitive culture. Of these aspects, illustrative of the process of primitive thought, totemism is merely included as one that in itself has no reality as a social institution, but rather as a system of thought. Here is an example of how the reader of this book not only will discover more about how primitive man thinks but will arrive at a better understanding of social organization in primitive society. Lévi-Strauss sees totemism as a classificatory system, rather than as an "institutional reality." He does not see it merely as a somewhat facile (and "primitive" in its other sense) means of tying two worlds together, but rather as a sensitive appraisal of the similarity of certain differences that exist in both nature and in human culture. Differences and distinctions of the kind so clearly symbolized in totemic systems exist in the practical world in which human societies are formed. Totemism expresses a system for ordering these distinctions and differences that can be transferred to different levels. No society can survive in disorder. On the one hand, primitive man recognizes disorder all around him; on the other, he perceives a system of order in certain natural phenomena. By transferring this system of ordered relationships to the level of his own experiences, he introduces stability, and resolves chaos.

Games, in primitive society, Lévi-Strauss points out, recognize the principle of differentiation, and indeed introduce inequality where previously none existed by forcing a stable situation to the point where one side is winner and the other loser. In the same way primitive religion is concerned with the same kind of distinctions and differences, but it takes inequality and reduces it to a great and all-pervading equality, finally equalizing the greatest and most obvious inequality of all, that between the living and the dead.

Lévi-Strauss sees myth as another example of the concern of the primitive

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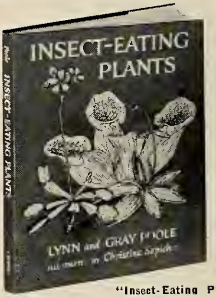

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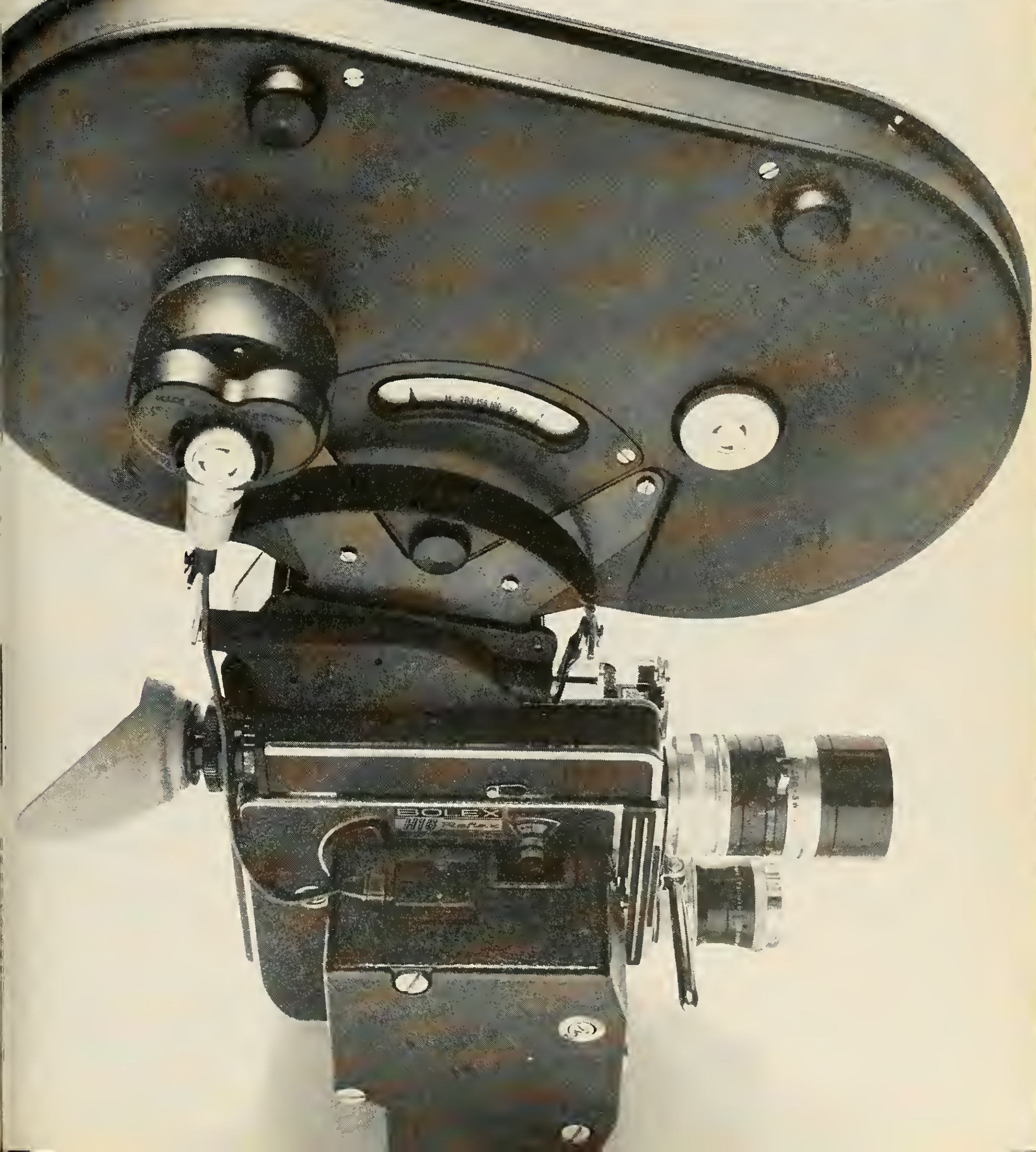

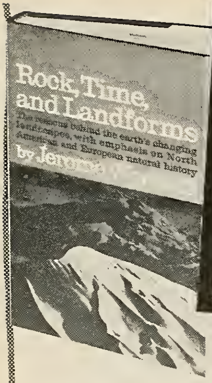
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mind for ordered relationships. Myth is not concerned, as has so often been thought, with the explanation of natural phenomena. Rather it is concerned with facts of a logical order, using natural phenomena to explain them.

For instance the many myths told by the forest pygmies concerning the relationship between elephants and mice, or other small animals, are not told because the pygmies are particularly interested in elephants and mice, let alone in trying to explain how elephants and mice get along together. The focus of interest is on quite another plane. The facts are as follows: In the forest there are villagers as well as pygmies; the villagers are tall and consider themselves superior; they follow an economy that is directly in competition with that of the pygmies. The villagers cut the forest to plant their fields; the pygmies need the forest as it is in order to hunt. In his myths the pygmy explains these facts by showing that a similar situation exists in the animal world and is ordered to everyone's satisfaction. The large clumsy elephant who destroys the forest in his search for food is constantly being outwitted by the smaller and more clever animals; the smaller animals are constantly able to avoid the larger ones, and even to take advantage of them by trickery. The pygmy sees, in the actual situations around him, in the natural phenomena he understands so well, the patterns and systems of order that he needs to solve his own human situation.

Primitive thought is not designed to meet practical needs, but intellectual ones. As a true scientific system of thought the one thing it will not tolerate is disorder. It is this passion fo order, recognizing it as indispensabl for survival, that characterizes th savage mind. This book shows the sam zealous devotion, reaching out into al corners of social activity, lending colo and direction wherever it touches. Customs that before seemed strange no appear as eminently logical and comprehensible; logic that before seeme remote and isolated is shown to be immanent and functional. The world o the primitive is no longer remote an unreal, nor indeed primitive, let alon savage. It is immediate, dynamic, an very real; if savagery is to be found it is more easily found in our own unthinking attitudes toward a world w do not understand.

Lévi-Strauss not only helps us t comprehend primitive society, he help us to respect it and, if we will, to lear from it. He writes with ease and el

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NTASTIC TREES, by Edwin A. ininger. *The Viking Press, $8.95; pp., illus.*

ised to think that gardeners' terms uch as "leggy" or "having wet " were the ultimate botanical ivalents of baby talk to Pekingese s, but when I pick up a book and l that plants that don't have their way will curl up and die, or that its that flower each day are over- r and possibly oversexed, or that its grown in extra wet places have control and have to be treated like grown infants, my reaction is to w the book out the nearest port- and head for the rail. Living room hiatric terms like indifference, shy- , show-off, refusal to compete, un- ained yearning, reluctance, and

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gregariousness are on facing pages of the prologue and are being applied to trees, not children, for heaven's sake!

Fortunately, I read Dr. Menninger's book in my office far from a porthole, for in spite of tooth-grinding cuteness, the book is fascinating. Some people collect antique Chinese jades, others save stamps, and there are many circus buffs. Dr. Menninger is a tree buff and has collected the gosh-darndest mass of information on unusual trees that could be imagined. His ecological foundation is shaky, his plant physiological background is nil, and his understanding of adaptation and evolution is "niller." His enthusiasm is, however, immense and catching. If you don't become a tree buff too, you can't blame him for a half-hearted effort.

In the course of evolution, many strange things have lived and still live on this planet; certainly the camel, the giraffe, and man would be unbelievable if described to an extraterrestrial visitor. Unusual plants are equally common, and those that are trees—loosely defined as tall, perennial, and woody—might be expected to include species with features that would surprise a person who grew up around elms, oaks, pines, and palms. Some of the adap-
tations of trees discussed in this boo
are probably evolutionary adaptatio
to particular conditions; others a
likely to be chance modifications th
have neither positive nor negative su
vival value and merely occurred an
were perpetuated; still others may i
the long run be deleterious.

With the variety of plant forms t
discuss, there are many ways in whic
this book could have been organize
Dr. Menninger has divided it int
thirty-four small chapters, each trea
ing a single, anthropomorphically base
plant group (odoriferous trees, tre
that shed their bark, etc.). Variab
numbers of chapters are grouped in
one of six major sections, again
anthropomorphic grounds. Frankly,
think that this organization is bett
than any that a professional botani
could devise.

The book is profusely illustrat
with photographs whose over-all qua
ity is average, but which frequent
leave something to be desired in ter
of presenting sufficient detail to achie
complementary balance between te
and picture. It is regrettable that t
photographs are not numbered to
them to the text, and one must sear
for the plant being discussed; this
the first error that can be laid at t
publisher's door. The index is ina
quate; this is the second error of t
publisher. The literature cited a
species names are arranged by chapt
at the end of the book, just where th
will be least used; this is the pu
lisher's third error. The inadequ
citations will not allow the curio
reader to follow up his interest in
particular plant, and this is likely
be the author's error.

To sum up: *Fantastic Trees* is
grand and glorious mixture of cute
accurate writing about a tremend
number of trees with unusual str
tures, habits, and locations; it is
viously the work of an enthusia
hobbyist. The book is recommende
anyone who would like to win b
bets in a barroom (what is the larg
seed in the world?), needs cockt
time chatter (did you know that . . .
is intrigued by the bizarre and strik
in the plant world, or just likes tr

RICHARD M. KI
The New York Botanical Ga

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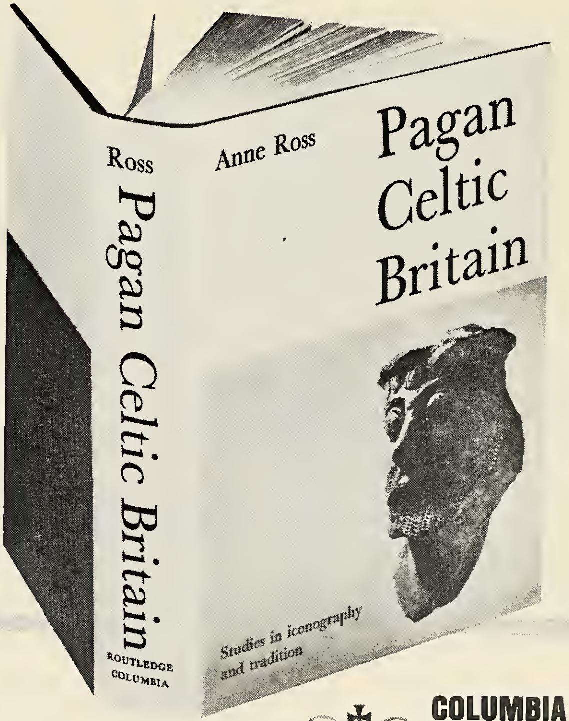

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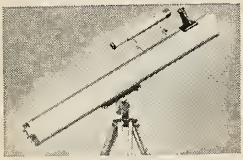

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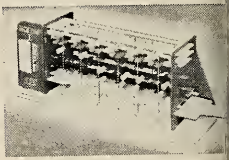

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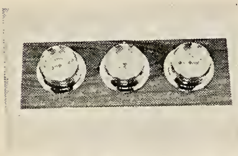

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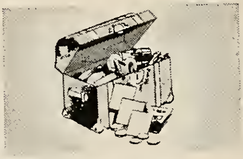

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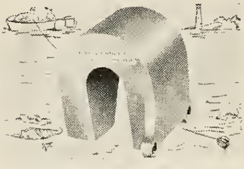

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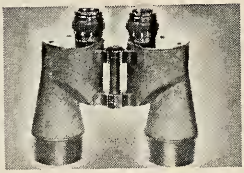

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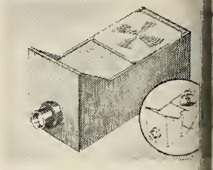

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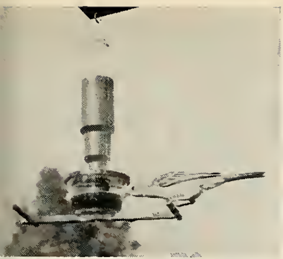

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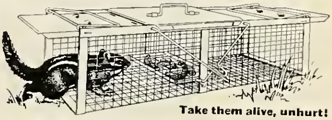

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basic fact was also revealed: The arsh had played a vital role in ture's master plan, providing ir-ation, as needed, to surrounding ests and plains. When Nature's lance was disturbed, floods and oughts plagued the land–a typical ult of man's misunderstanding of ture's ways.

To mend the damage, a dam was built. But due to conflicting interests, the marsh was later drained again...then dammed again – a seesaw battle that lasted some thirty years.

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Natural History

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E JOURNAL OF THE AMERICAN MUSEUM OF NATURAL HISTORY

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VER: In the December, 1965, NATURAL HISTORY, Edward T. Hall discussed ritorial needs and limits of animals, emphasizing particularly the space uirements of individuals. This month's cover, which shows a section of a ged Penguin (*Pygoscelis antarctica*) rookery in the South Shetland Islands, an excellent example of how some animals space themselves in crowded ations. The reddish cast of the ground is produced by the regurgitated tter that adults feed to the young. Penguins are one of the focal points of bert Cushman Murphy's look at the need for conservation in Antarctica.

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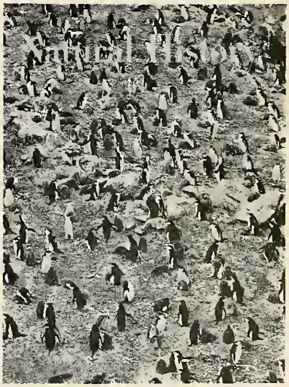

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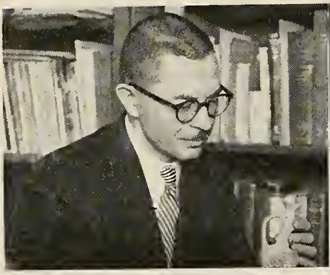

Philip C. Hammond

Marc Riboud

Anthony Netboy

RONALD DAVID CORWIN, author of "Dilemma of the Iroquois," has a special interest in the problems of minorities. A lecturer in sociology at University College, a division of Syracuse University, Mr. Corwin expects to receive his doctorate in sociology from Syracuse this summer. His masters degree, also from Syracuse, was in psychology. During the past legislative session, Mr. Corwin was research consultant to the New York State Senate Minority Leader. He had previously served as an assistant project director for the Peace Corps, as an interviewer for the New York State Office of Education, and as a consultant for the New York State Medical Association.

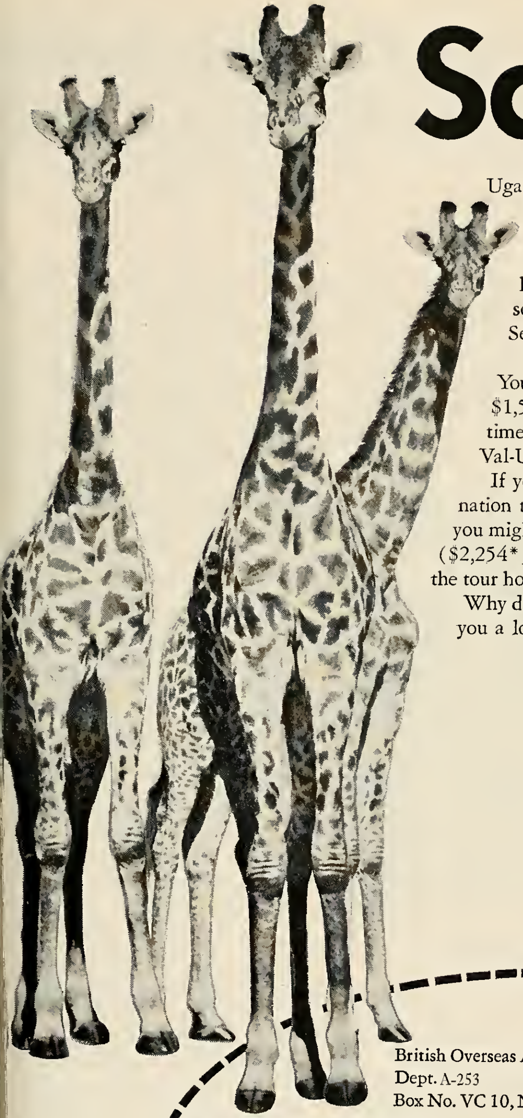
ROBERT CUSHMAN MURPHY made his first expedition to Antarctica in 1912 and his most recent in 1960. He has led numerous other expeditions, mostly at sea and to island groups, but also to every continent except Australia. Dr. Murphy has been connected with The American Museum of Natural History since his first job as an assistant in 1906. He served as Curator of Oceanic Birds from 1926 to 1942. He is presently Lamont Curator Emeritus of Birds and a Research Associate. Dr. Murphy's publications, both scientific and popular, number more than 500, including many books. He is a past president of the National Audubon Society, the American Ornithologists' Union, and the Biological Laboratory at Cold Spring Harbor, and a fellow of numerous professional societies. Jean Le Corbeiller wrote the spirited portrait of Robert Cushman Murphy that introduces "Antarctica." An editor with Natural History Press, he is currently preparing a history of The American Museum.

THOMAS EISNER studied the strange relationship of the caterpillar and the sundew plant at The American Museum's Archbold Biological Station in Florida. His work was done with Julian Shepherd, a graduate student at Harvard. Professor Eisner teaches and conducts research at Cornell University on the physiology, biochemistry, and behavior of insects. In addition, he is acquiring a mean reputation in the Ithaca area as a harpsichordist. Author of numerous papers, Thomas Eisner is a frequent contributor to NATURAL HISTORY.

PHILIP C. HAMMOND, author of the article on the ancient Nabataean waterworks, is Associate Professor of Mediterranean Archeology at Brandeis University. He has long combined his interests in religion and archeology; he holds a doctorate in Near Eastern Archaeology from Yale University and an undergraduate degree in Biblical Literature from Brothers College. Also a graduate of Drew Theological Seminary, Dr. Hammond is former Assistant Professor in Old Testament at Princeton Theological Seminary. He has directed several archeological expeditions and has published numerous articles in both religious and archeological publications.

MARC RIBOUD, who recently spent five months in China, believes, "The best, and possibly the only way of discovering China is to look at it." This month we look at Riboud's photographs of the nomadic people of Inner Mongolia, a little-seen autonomous region of China. A noted French photographer, Marc Riboud has traveled and exhibited extensively. He recently won the Overseas Press Club Award for the best photographic reporting or interpretation from abroad for his new book, *The Three Banners of China.* Mr. Riboud joined Magnum Photos in 1954. His wife, Barbara Chase Riboud, a sculptor, often travels with him; he diary is quoted in the text accompanying the photographs.

The Atlantic salmon is on the lis of endangered species presented to th public by Secretary of the Interio Udall. ANTHONY NETBOY writes of th fate of this salmon in this month' article and in a book, *The Atlanti Salmon: A Vanishing Resource?* t be published by Faber & Faber i London this fall. Mr. Netboy is A sistant Professor of English at th Portland Continuation Center of th Oregon State System of Higher Educ tion. He has worked for various b reaus of the United States governmen specializing in popularization of sc entific materials. In 1963, Mr. Netb first began his study of the Atlant salmon in Europe with a grant fro the Conservation Foundation in Was ington, D. C.



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DILEMMA OF THE IROQUOIS

By R. David Corwin

At the zenith of their influence the Six Nations of the Iroquois dominated the entire northeastern portion of North America. Their confederacy was more powerful and more politically sophisticated than any other group of Indians above the Mexican border. In the northeast they had annihilated, expelled, subjugated, aligned with, or absorbed all other tribes. The core of Iroquois power, however, was centered between Lake Erie and the Hudson River, in what is now upper New York State.

Here, remnants of the confederacy linger. Here, therefore, we can focus on an increasingly debated problem: how to reconcile national policy with the wrongs inflicted upon the American Indian and the rights he demands. The treaties with the Iroquois are clear enough. The trouble is that Iroquois quote them and non-Indians ignore them. This, plus various differences in viewpoint, has bred bitterness, and has also created a dilemma for the Iroquois. If they join the rest of society, that path leads to their dispersal as a people. If they do not join, that path leads to the same end.

But first, who are these Indians? The Iroquois Confederacy began late in the sixteenth century with three nations. While the Mohawks, Oneidas, and Cayugas were forming this bond, Tododaho, the legendary Onondaga, was at the height of his military power and defeated the Senecas as well as the Cayugas. His price for allying his Onondagas with the confederacy was that the Senecas also be admitted to its governing council and that the Onondagas dominate it. Later, in 1714, the increasing pressure by American colonists drove the Tuscaroras out of North Carolina. They fled northward and in 1722 were admitted to membership as the sixth nation. The Onondagas remain dominant to this day. Their reservation is capital of the confederacy; the chief of the Six Nations must be an Onondaga, and is given the glorified name Tododaho.

Throughout the years, of all the Indian nations that Europeans found in the New World, only the Iroquois Confederacy was never conquered. Holland, England, and France even sent ambassadors to this sovereign government. Eventually, however, events of the American Revolution cracked the solidarity of the Iroquois. Most fought for the British, but even those who aided the Americans were to be counted among the losers. The famous treaties of 1784 and 1794 required the Iroquois to sell the Americans all of their lands south and west of New York State. They did, however, retain independence as a nation and title to their remaining lands "forever."

Martin Seneca explains his people's bond to their land: "Where would the Irish be without Ireland?"

But New York wanted to force these "hostile" Indians out of the state—it wanted their remaining land. So New York accused the federal government of usurping state's rights. The Indians, for their part, played both ends, signing treaties with the state and the federal governments. The over-all result is tha jurisdiction over them in New York has sometimes been federal; occasionally state and federal governments have acted in concert; bu more recently, Indian affairs have with few exceptions, been entirel New York's responsibility.

When the treaty of 1784 wa signed, New York's Indians retaine title to about 18,000,000 acres o land. Now, due to outright sales treaty violations, treachery fror within and outside the tribes, an inability to defend their claims, th Iroquois own only 77,000 acres, an fear losing even this land. In thi they share with the nation's othe reservation Indians a collectiv dread of "termination."

Meanwhile, there is general cor fusion and disagreement about th Iroquois' legal status. They then selves are split on this issue. Th more conservative group, the Lon house people, insist they are citizei of sovereign nations, independent the United States. (Originally, Iroquois lived in communal dwe ings they called longhouses, but no the longhouse is "the temple, tl center of the ancient religion, ar the council chamber where practic decisions are made.") The oth group, more progressive and most Christian in religion, see themselv as citizens of both the United Stat and New York State who posse special rights and privileges becau

The land is my mother. You cannot sell your mother"—
so these remnants of the once mighty Six Nations
cling to life on the Indian reservation.
But whether they welcome modern ways or resist them,
they face dispersal as a people

they are descendants of the land's original "citizens."

These differences, however, are dwarfed by an anguish shared by the Iroquois in general. It concerns termination of the reservations. The land has deep meaning to them—especially to the Longhouse people, for whom it has religious significance. The Indians predict that destruction of the land base will scatter them, will demolish their culture, nations, and people.

"Our forefathers' bones are in the land," say the Iroquois. They explain that their responsibility is to preserve it for their children and the yet unborn generations. Their anxiety over termination is understandable; they view American his-ory as a land grab that still goes on. n the past ten years they have lost housands of acres to government agencies for dam-building projects and the like. Even those progressive Iroquois who look ahead to many benefits from the compensation money will resist any governmental ttempt to terminate the reservations.

The Iroquois learned from pain-ul experience; today's reservations re only a splinter of the past. With he Oneidas the state's plan to scatter he Indians to the west was very suc-essful. After losing practically all of heir holdings, most Oneidas moved o Wisconsin. Similarly, the Cayugas ent on to Ohio and Oklahoma. The emaining four nations have also een their land base dwindle, and most of their people feel that, despite esistance, in time they will lose the est. Of these, the most bitter are the nondaga, in contrast with the eneca, who also have the will to esist but are more flexible.

Keepers of the Wampum

Although Onondaga means "on e hills," the reservation lies in a valley just south of Syracuse. Still the capital of the confederacy, its 6,100 acres are home for 1,100 Onondagas, plus some Mohawks, Cayugas, and Oneidas. At first glance it looks poor: many unpainted wooden houses; an automobile graveyard at one corner, industrial dumping at another; yards cluttered with jalopies, chicken wire, broken toys. A deeper look, however, reveals some distinctly modern homes, with white picket fences and verdant front yards dotted with shining ornaments, a neat, relatively well-equipped elementary school for reservation children, and even a small airport for private planes.

But none of this makes the Onondagas forget their leading role in the confederacy's council. They are the "keepers of the central fire" and the "keepers of the wampum"—belts of shells that carry the laws written in symbols. (For many years, however, New York has stored these belts at its state museum, claiming they are priceless and fragile.) Among the many ancient rituals and social patterns that the Onondaga preserve are the false-face ceremony (a rite for curing illness); the ceremonious gathering at Onondaga of Longhouse chiefs (still elected by the clanmothers); the old stick-throwing game of snow snake. Iroquois youngsters are taught the Onondagas' ancient tongue. It is useful later when the Indians want to talk among themselves.

Near the center of the reservation is a tombstone marking the remains of Handsome Lake, the great Iroquois prophet. In the early 1800's, he began exhorting the Indians to control their drinking and other imitations of the white man. Estimates vary concerning the influence of his "good message," but his teaching still provides spiritual guidance for many Iroquois. Across the road from his tombstone is the wooden, white-painted Longhouse, with benches along the inside walls. In this rectangular building the Six Nations Council is convened by today's Tododaho, chief of the Iroquois Confederacy. His ancient name means "he whose house blocks the path," and some non-Indians think the Onondagas are still obstinately blocking the path—impeding progress, so to speak. The Onondagas reply they are simply trying to preserve and protect the ancient culture. This clash has had its effect. Of all Iroquois reservations, Onondaga is the most tense and openly agitated.

Because "white men only talk to us when they want something," the Onondagas are wary about discussing their problems with a stranger. But once they agree to talk they are eloquent and candid. The following is from my notes on one meeting:

"Meeting of the Chiefs' Council in the Longhouse at 11:00 Sunday morning. A typical church hour, so Christian Iroquois would probably not be there. I found twelve men and two women in the room. One man was standing and speaking Onondaga. (It sounds like chanting rather than speaking.) After several minutes he asked me to state my business, which I did. The men began talking quietly in small groups. After fifteen minutes Louis Papineau, a Mohawk married to an Onondaga, rose and began to speak.

"He said first there should be a 'revision' of annuities, fixed by the treaty of 1788. The Onondaga are annually paid $2,430, plus salt, for land taken from them. Last year this amounted to a little over $2 per capita, and will dwindle as the number of people on the reservation grows. Others joined in. A young

Continued on page 60

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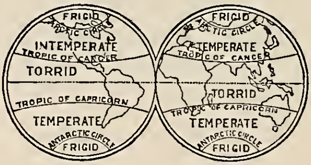

A Naturalist at Large

One gets the impression, these days, that everyone has become aware of the environment. The President makes speeches about the quality of the environment; the Mayor of New York has discovered air (Los Angeles discovered it long ago); and the Department of Health, Education and Welfare has started work in North Carolina on a gigantic center for the study of environmental health. There have been endless committees, commissions, conferences, and symposia—all producing reports. I have a large pile of the reports here in my study, with titles like *The Dynamic Spectrum: Man, Health and Environment; Environmental Quality in a Growing Economy; Air Pollution; Waste Management and Control; An Ecological Approach to Environmental Stress.* There are dozens more, but that should give the idea.

Of course the environment is not new, nor is awareness of man's effect as an agent of environmental deterioration. The classic book on the subject, *Man and Nature; or Physical Geography as Modified by Human Action,* by George Perkins Marsh, was published in 1864. It was reissued in 1965 by Harvard University Press with a historical and biographical introduction by David Lowenthal. Marsh's book was widely read in the latter part of the nineteenth century, and it had considerable influence on the thinking of many people. Among other things, it led directly to the establishment of our Forest Service and national forest reserves. Secretary of the Interior Udall has well said that it marked "the beginning of land wisdom in this country." The book still reads easily, with an up-to-date feeling except for occasional anachronisms, such as remarks about malaria being caused by bad air.

Yet our wisdom about the environment, about the land we inhabit, sometimes seems not to have shown much growth in the hundred years since Marsh published his book. In fact, the current outpouring of reports, studies, plans, and laws could be taken as an indication that environmental deterioration is reaching crisis proportions. We seem t require a crisis before starting t take effective action—which make one wonder about all this talk o man as a "rational animal."

Environment—I can remembe when I thought it was a rather simple idea. It meant the setting, th surroundings, of an individual, population, or a biological community. But the more I have though about it, the more confused I hav become, which is a not-unusual cor sequence of concentrating on som particular idea. One difficulty is tha organisms and their environment form interacting systems, modifyin each other in varied ways. The typ of forest, for instance, that grows i a particular region depends in pa on the regional climate and soil; bu the type of soil is also a consequen of the kind of forest (coniferou hardwood, or what), and the pre ence of the forest results in modi cation of the climate. These sorts

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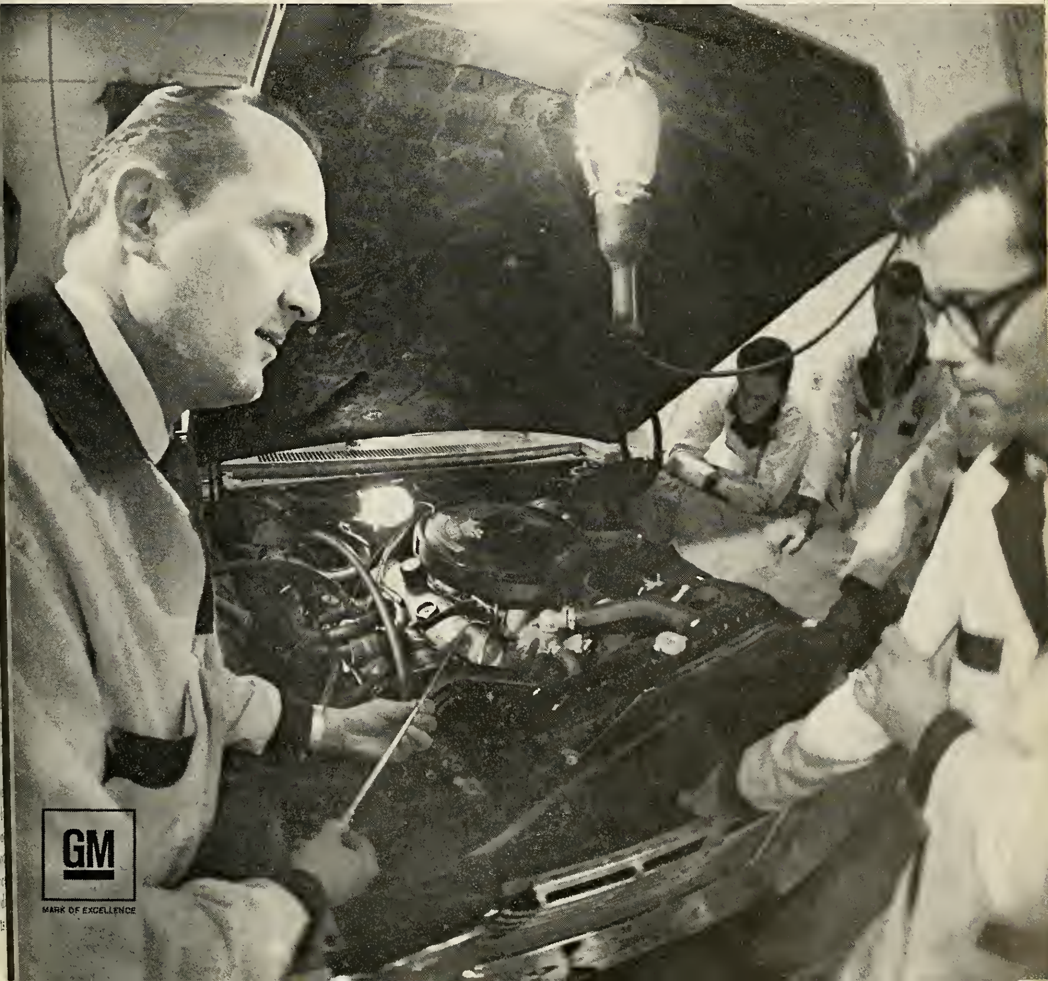

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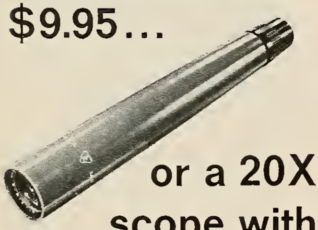

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relations have led ecologists increasingly to try to think in terms of ecosystems: of living organisms and physical factors in the environment forming parts of interrelated wholes.

When we turn to man, then, we would do well to think, not so much about the human environment, as about the human ecosystem. An increasingly large proportion of the earth's surface is being altered by human actions—and this in turn is coming to govern what men do or can do. Ecologists, who tend to be fond of big words, sometimes call this man-dominated region of the globe the "anthroposere"; or, following a Russian named Vernadsky, the "noösphere," the world of the mind, which is coming to replace the "biosphere," the world of life. I dislike both of these words and prefer to think about "the man-altered landscape," though I do wish I had a better phrase.

The human ecosystem involves a particularly puzzling and complex set of interrelations among its organic and inorganic components. I first became fully aware of this when I was asked, a few years ago, to talk about "the environment" with one of the national committees that had been formed to consider our resource problems. I made a fairly conventional sort of analysis in terms, particularly, of the perceptual environment (the aspects of the world about us that we are able to intercept and interpret with our sense organs) and the operational environment (things that affect us physically even though we cannot directly perceive them, such as viruses and some kinds of radiation). When I had finished, Peter Murdock, an anthropologist who was present, asked, "What do you do about the supernatural environment?"

This gave me pause. I had recently spent some time on an atoll in Micronesia where spirits were very common. They were as "real" to the people as, say, the sharks in the lagoon—and far more important because they could, if not properly propitiated, do a great deal more damage, by calling up a typhoon or causing an epidemic. We, with our background of Western science, knew that the spirits were not really there; they were creations of the minds of the people. But their

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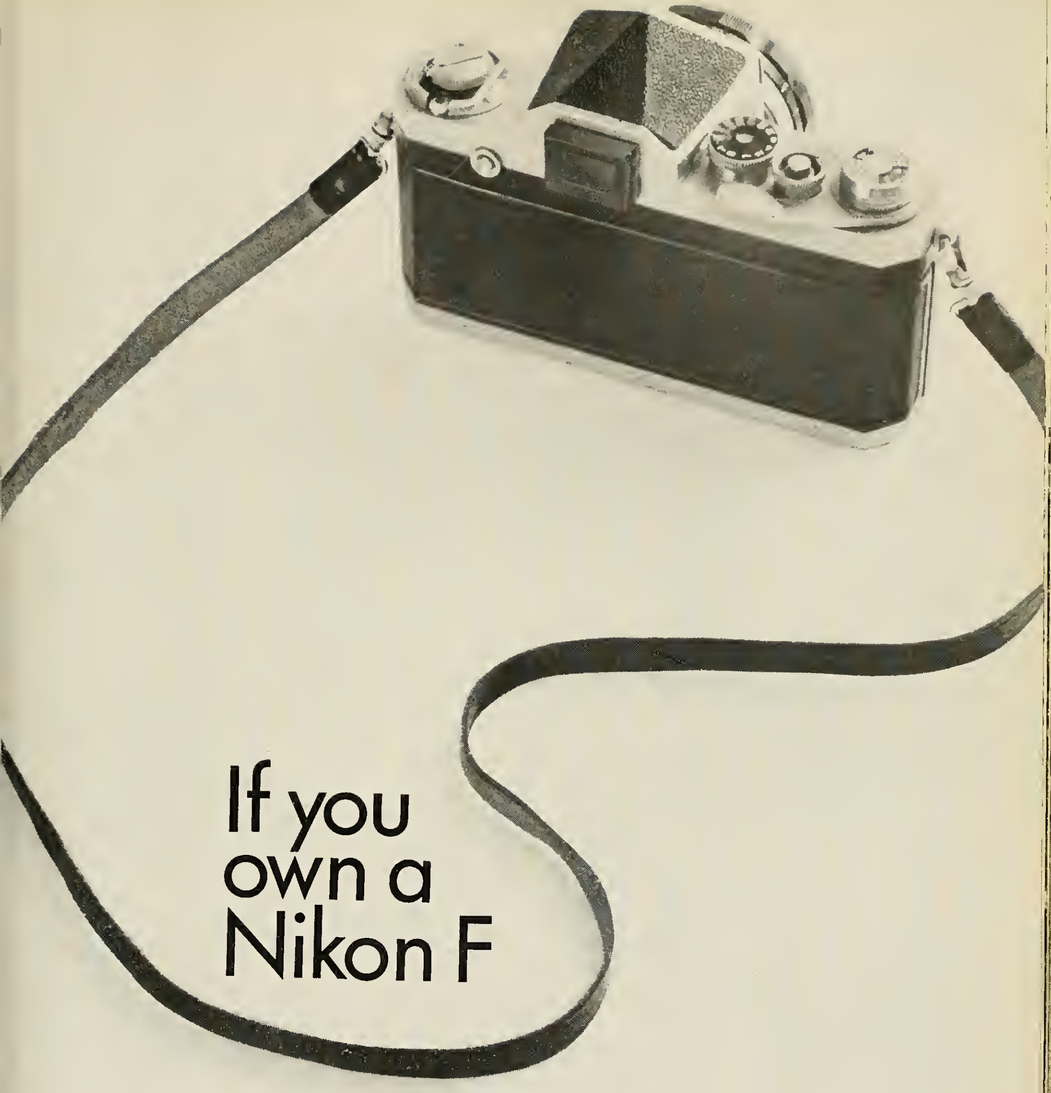

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influence on human behavior, as a part of the atoll environment, was undeniable.

Discussion of Murdock's idea rapidly became general. We did not believe that there were any spirits lurking in the board room of the National Academy of Sciences, where we were meeting. But we soon realized that the place teemed with various ideas and attitudes that the individuals present had acquired from their cultural backgrounds—we were really in no position to feel superior to the Micronesians. I think it was the botanist Ray Fosberg who came up with the suggestion that we should talk, not about the "supernatural environment," but about the "conceptual environment": the world of ideas that surrounds every man and so greatly influences his beliefs and behavior.

This brings us back to the ecosystem, to a special case of the interaction of organism and environment. Our culture—which I presume is the conventional term for our conceptual environment—is developed by people, perhaps in part by individuals, but more by the accumulated traditions of groups. We made it, but it in turn molds our actions, our way of life.

Sometimes I visualize this most easily in terms of clothing and housing. What we wear is determined by our ideas of what we ought to wear; only in such cases as space suits and arctic garments has practicality won over appearance. Many studies have shown that from the point of view of comfort and physiology, the ideal clothing for the wet tropics is no clothing. But even when we move into this environment, we cling to our ideas of propriety and find it easier to change the climate with air conditioning than to take off our clothes. This is a particularly sore point with me because I hate the tight feeling of a necktie: yet on the lecture platform or at a committee meeting, there I am, following the laws of convention. At least it enables me to make the point sometimes about the compelling influence of the conceptual environment on human behavior and physical comfort.

Lynn White, Jr., Professor of History at the University of California, Los Angeles, has published a most thought-provoking article in the

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uis Jiminez is starting 4th grade a little late.
hanks to the Smiths.

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the brightest, most ambitious
dren can't afford. So it didn't
rise anyone when Luis Jiminez
ped out of school in the third
e. The big surprise—Soacha
it a little miracle—is that Luis
back to school this year.

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e it happen. Through *Save the*
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a month to give Luis a chance
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hrough law school. John might
about his work as a teacher of
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ted in their charming colonial
house in southern Connecticut.
lmost paid for. The Smiths are
g way from being wealthy. Al-
gh you'd have a hard time tell-
at to the people of Soacha.

Until the Smiths came along,
Soacha had any knowledge of
the outside world.
They knew a lot
about desperate
poverty, hunger
and hopelessness,
though. Take Luis'
father, for exam-
ple. His take-
home pay is $10
th. He has five children to feed.
l for Luis wasn't in his budget.
ut this was before the Smiths.

Smith first became interested
ve the Children Federation
she worked for them last year.
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rs for people with the money
ed from sponsors. Now the
s are sponsors. And their $15
th is doing wonders for Luis,
nily and even the village.

is is back in school. Luis'
has a small patch of land he
ever cultivated because he
not afford seed and fertilizer.
ear he is growing corn. With
, there is still money left over.
noney, together with funds
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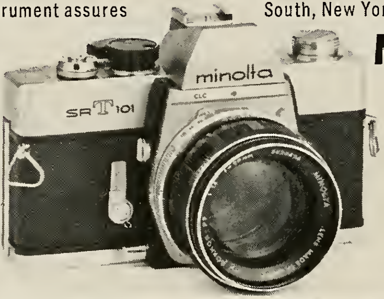

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issue of *Science* for 10 March 1967, entitled "The Historical Roots of Our Ecologic Crisis." He sketches developments in the history of the Judeo-Christian tradition that have led to our present worship of science and technology—and to the present crisis in our relations with the rest of nature. White feels that today's patching and mending is, finally, futile without some large change in our attitude—in our religion.

"There are many calls to action," he writes, "but specific proposals, however worthy as individual items, seem too partial, palliative. negative: ban the bomb, tear down the billboards, give the Hindus contraceptives and tell them to eat their sacred cows. . . . What shall we do? No one yet knows. Unless we think about fundamentals, our specific measures may produce new backlashes more serious than those they are designed to remedy." We need, in terms of my phraseology, to modify our conceptual environment.

In the meanwhile we are living—and in the course of our summer vacations we will be traveling—in a man-altered landscape that is the consequence of our ideas. The supremacy of the automobile, the pattern of highways and towns and cities, the forests that are gone and those that are left as parks or reserves, the animals that are protected and those that are persecuted —our whole ecosystem is shaped by the concepts of our culture.

This ecosystem is curiously neglected as a subject of scientific study. Ecology and economics have the same Greek root (from *oikos*, the household). Yet when one looks at the textbooks and college courses, there is almost nothing in common. When I wrote *The Forest and the Sea* back in 1960, I made the quip that ecologists like to play the game of pretending that man doesn't exist, while economists, correspondingly, like to pretend that nature doesn't exist. Although there is an increasing amount of communication between the two groups, we still have a long way to go before we achieve any real understanding of the problems of man and nature.

The ecologists are beginning to discover the man-altered landscape, and I have attended a number of meetings on the subject—always getting new ideas, and sometimes new

e Hasselblad system...
d a few reasons why the scientific and industrial photographer needs it.

applications of photography cience and industry are erous and undisputed. It ld require many volumes er than this single page just st, let alone discuss, these cations. Both as a research and a recording device, tography has certainly ed not only convenient, but any cases of sophisticated ntific and industrial arch, invaluable.

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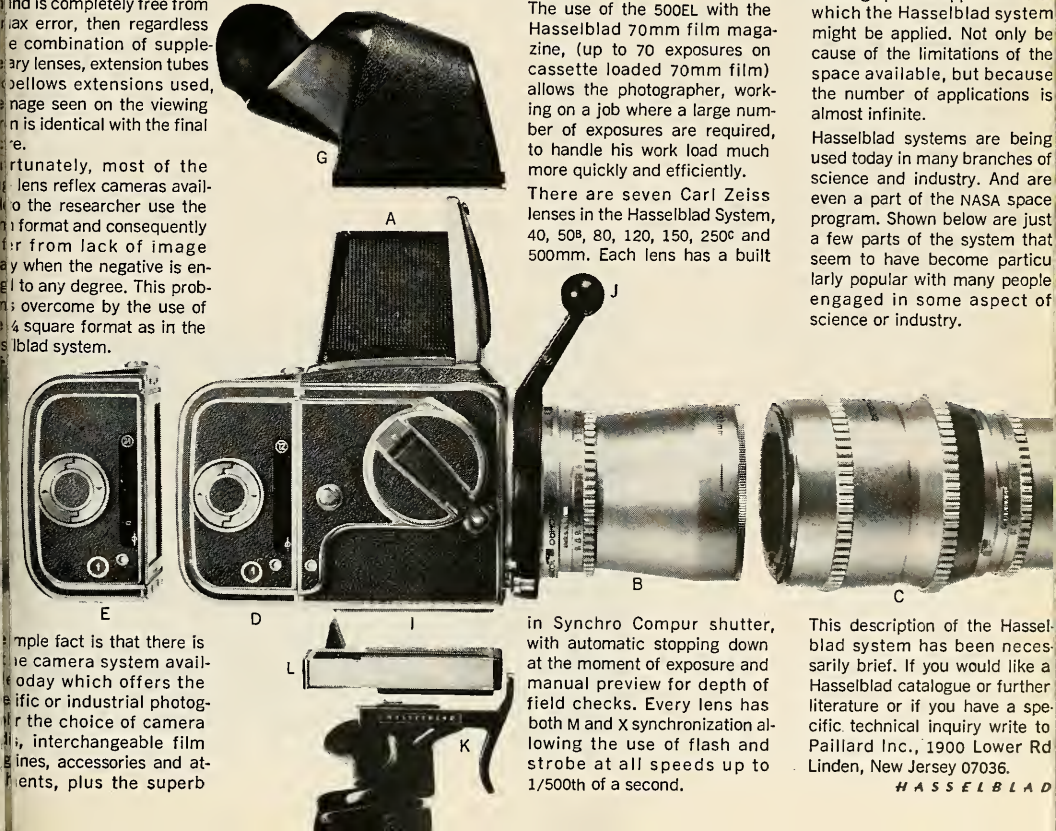

mple fact is that there is e camera system avail- oday which offers the ific or industrial photog- r the choice of camera , interchangeable film ines, accessories and at- ents, plus the superb optics of Carl Zeiss lenses with built in Synchro Compur shutters allowing the use of both flash and strobe at all speeds, that the Hasselblad system does.

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Five different instantly interchangeable film magazines are available. These magazines allow the photographer to make 12 or 16 exposures on 120 film^{D}, 24 exposures on 220 film^{E} and 70 exposures on 70mm film. The magazines also allow the choice of 3 formats (2¼ square, 2¼ X 1⅝, 1⅝ X 1⅝) This allows not only for speed of operation, but the convenience of being able to change either film type or format in mid-roll.

Completing the system is a huge range of accessories that includes extension tubes and bellows extensions for close up work, filters, transparency copy holders, cut film backs eye level prism finders^{G}, sports view finders, sun shades rapid winding crank^{I}, quick focusing handles^{J}, grips^{K} underwater housings, ring lights tripod quick coupling^{L}, microscope attachments and carrying cases.

We have purposely avoided discussing specific applications to which the Hasselblad system might be applied. Not only because of the limitations of the space available, but because the number of applications is almost infinite.

Hasselblad systems are being used today in many branches of science and industry. And are even a part of the NASA space program. Shown below are just a few parts of the system that seem to have become particularly popular with many people engaged in some aspect of science or industry.

This description of the Hasselblad system has been necessarily brief. If you would like a Hasselblad catalogue or further literature or if you have a specific technical inquiry write to Paillard Inc., 1900 Lower Rd Linden, New Jersey 07036.

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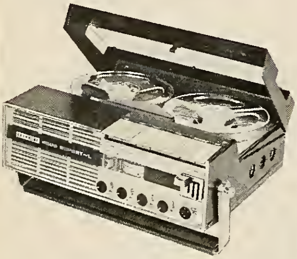

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words. I am especially fond of some of the words. There is, for instance, the "suburban forest," which stretches along the eastern seaboard from somewhere north of Boston to the suburbs of Washington. The forest tends to be continuous, surrounding the cemented islands of the cities themselves, and a whole series of animals have adapted nicely to life in this habitat: a variety of birds and such mammals as squirrels, opossums, raccoons, and even skunks. I have thought that many of these animals should be grateful to people—squirrels, in particular, since they are so much more abundant and well fed there than in other types of forest.

And then at a conference in Connecticut, I remember someone using the phrase "derelict woodland" for the growth on abandoned farms and for those forests along rivers that were badly cut over in the last century for firewood for the river boats. In the case of Connecticut, one third of its area is now under cultivation (or taken over by cities or suburbs), one third has been cleared but is now abandoned, and the other third has been cut over but never completely cleared. What to do about this derelict woodland that covers two-thirds of Connecticut is somewhat of a puzzlement—should it be managed or left alone?

I picked up a new phrase the other day from an official of one of our western states who did not think much of the primeval forest. "Decadent forest," he called it, littered with unused and rotting logs; quiet and dark, with its animal life unapparent at least to the casual visitor. Man, he felt, could do a great deal to improve this sort of situation by cleaning the place out.

We are concerned with a question of values: some people like the man-made environment of cities as a permanent way of life, others like to escape when they can, and still others are perfectly happy without ever going near a city. We need more study of the psychological factors involved, as well as of the physical effects of pollution of air, water, and soil. But we need to know more about all aspects of the man-altered landscape, because this, after all, is the world in which most of us are forced to spend our lives.

Lynn White, in the article I quoted earlier, suggested that St. Francis of Assisi should be the patron saint of ecologists. "The key to an understanding of Francis," White writes, "is his belief in the virtue of humility—not merely for the individual but for man as a species. Francis tried to depose man from his monarchy over creation and set up a democracy of all God's creatures." Unfortunately St. Francis failed. "Both our present scienc and our present technology are s tinctured with orthodox Christia arrogance toward nature that n solution for our ecologic crisi can be expected from them alone."

But the answer, immensely difficult though it is, seems simple. Ou troubles stem from our conceptua environment. We made it. All w have to do is to change it!

Gray squirrels, as well as some other small mammals, are prospering in suburb

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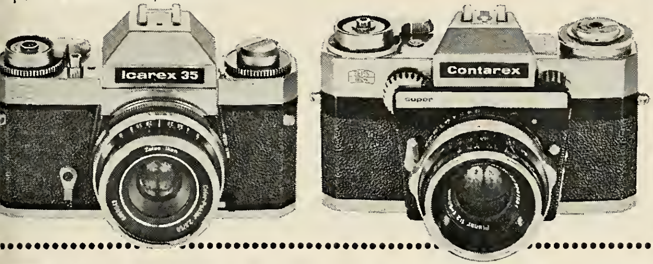

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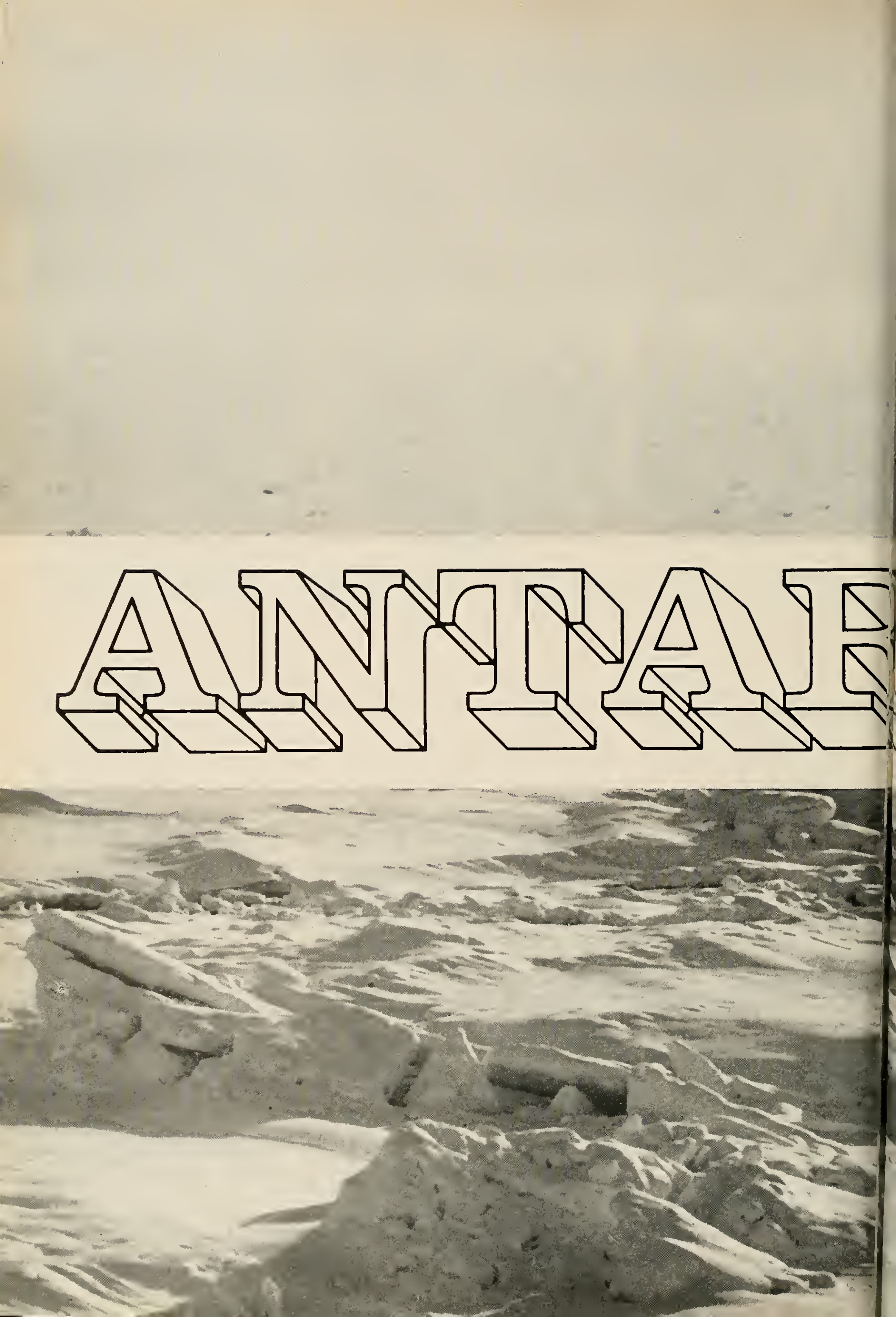


ANTA

CTICA

About the Author

There are days when a cool sea breeze seems to blow through The American Museum of Natural History—as if the Museum's walls had disappeared and the Museum itself somehow stretched far below Manhattan Island, past the Caribbean, and into the southernmost reaches of South America. The breeze carries saltness and openness and the cries of petrels and terns. It is on such days that those of us who work in the Museum know that Robert Cushman Murphy is about. If the Museum's youngest visitors don't recognize this tall man with the unbelievably distinguished voice, the Museum staff knows him very well indeed. One likes to think that a legend may yet survive among the Gentoo Penguins of South Georgia Island far in the South Atlantic of a tall young naturalist from a northern island—Long Island, Whitman's "fish-shape Paumanok"—whose eye could spot a leopard seal faster than they could themselves. But this was in 1913, when young Murphy, fresh out of college, had joined the whaler Daisy *on his first field trip to the earth's southern frontier. It had been a long journey, relieved by wonderful observations and by long chats with Correia, the Azorean ship's cooper. But at South Georgia, twelve hundred miles east of Cape Horn, Murphy was in his element. Where else could he eat fresh fish from the stomach of a dolphin or spend days and days exploring colonies of Wandering Albatrosses and Giant Fulmars? There he was, a Brown varsity sweater under his dogskin coat, sitting in his tent on the Bay of Isles, awaiting the next great splash as a berg broke off from the glacier opposite him. And during lunch—an albatross-egg sandwich—he could watch the white-capped Gentoos pace back and forth on the Jurassic shingle. He had found his calling; for the next half century he would be America's ambassador to the penguin, the petrel, and the tern.*

His far-seeing eyes have studied the flight of more marine birds than have those of any other human being. Decade after decade he has represented The American Museum on the dour, rain-soaked coasts of Ecuador, in the green, mineral-laden waters of the Humboldt Current, in the gray, storm-lashed endlessness of the South Pacific, and on uncounted islands of southern oceans on which terns, sheathbills, and flamingos alight to rear their young.

As the 1930's advanced, Murphy realized that he was in possession of a priceless bit of understanding: the oceans, which for the rest of humanity were one vast body of salt water, for him were composed of a multitude of distinct, clearly delimited habitats. Not for nothing had he been born in the very year Victor Hensen coined the word plankton. *Murphy came to know the oceans as groupings of wholly different life zones with waters whose sharply differentiated temperatures and mineral content formed the ecological base of separate worlds of plankton. Each planktonic community, in turn, supported a wholly individual assemblage of marine birds. In his* Oceanic Birds of South America, *he placed his favorite groups of birds in their natural relations to their environment with a grace and an understanding that opened up an entirely new dimension of life on this planet.*

In 1938 The American Museum appointed him Curator of Oceanic Birds, recognizing his dominion over the realm of zoology he had brought into being. He continued his field work—in the 1940's he reported to readers of Natural History *on "The Lost World of the Takahe," a gallinule that turned up as a "living fossil" in New Zealand; in the 1950's he enthusiastically reported the survival of the Cahow, a Bermuda petrel thought extinct since 1620. In 1960 he signed on as zoologist aboard the icebreaker* Glacier *for service in the Bellingshausen Sea in the Antarctic.*

Today, in a museum he has done much to shape, Robert Cushman Murphy's presence is still deeply felt. He is eighty now, and still stands a little bit taller, a little bit straighter than anyone else around. To a reader of his Daisy *journal, there is something startling (but also deeply satisfying) about seeing him pass by the bust of Daniel Giraud Elliot, a much admired zoologist of the turn of the century, on the Museum's second floor. It brings back a near memory that a bit of page-turning soon confirms in his journal entry for 28 September 1912: "The chief drawback to a day below is that I have to stoop wherever I go and, indeed, whenever I stand. I want to live up to my promise to reach old age with the carriage and bearing of Daniel Giraud Elliot."*

As a species, we take pride in being more upright—in as many ways as possible—than other primates. As Dr. Murphy strides through the halls of The American Museum, his eyes seem to see beyond all obstacles—and they seem to reach for a distant horizon where air and ocean meet and where sea birds in a clamorous and unlimited variety fill the air.

Jean Le Corbeille

THE URGENCY OF PROTECTING LIFE ON AND AROUND THE GREAT SOUTHERLY CONTINENT

by Robert Cushman Murphy

Beyond doubt, the Antarctic is e only facet of our world in which an has not yet lived long enough have had an overwhelming effect pon the native ecosystem. Everyhere else he has transformed priordial conditions to such an exnt that we have only a vague idea what they once were. Man, roughout his latter cultural hisry, has shown that he is the sole satiable predator because, unlike l other animals, he takes his prey ostly from motives other than ose of personal survival. Places in hich we can observe and experient in a primitive climax grow arcer year by year, or day by day, ut in Antarctica they remain thus r at our service.

The water and land enclosed with- the Antarctic Circle are unique several ways. Their relationships th both higher and lower belts of titude are different from those of rresponding areas around the rthern end of the earth's axis. uthward from the North Pole and ctic Ocean, for example, there is relatively rapid climatic transition om polar to subarctic, to coldmperate, to warm-temperate. In e Southern Hemisphere, however, have to forget the equivalent poions of the two polar circles and recognize that the antarctic enonment is actually three times ger than the arctic environment.

The continental climate of high itudes in the Northern Hemihere assures mild summers and a rich diversity of plant and animal life. Antarctica, on the contrary, has a broad belt of oceanic climate surrounding the lofty and frozen interior. Instead of being closely rimmed by land masses such as Eurasia and North America it is by far the most isolated part of the world. The narrowest gap that separates it from other continents south of the Equator is the 700-mile reach across Drake Passage, from the Antarctic Peninsula to Cape Horn.

That Antarctica is by far the most insulated area on earth is equally meaningful. It is meteorologically buffered from all other land by a wide and permanently cold ocean and an overlying ring of circling winds. It has been well said that Antarctica has "trapped" its own cold—which is fortunate for air-breathing life everywhere else.

Site of a present-day ice age more stupendous than the northern Pleistocene glaciation, Antarctica thus far shows no sign of a coming interglacial stage. The twin factors of isolation and insulation seem to forestall that. Melting of the load of antarctic ice, which is 90 per cent of all the ice in the world, would raise the ocean level by at least 200 feet. But most glaciologists believe that the six or more million cubic miles of antarctic ice are not lessening, despite the recent worldwide trend toward climatic amelioration. Warming, indeed, may only supply more moisture from the north to swell the scanty antarctic precipitation and thus add to the ice cap. Russian glaciologists have found reasons for concluding that antarctic stored ice may be growing at a net rate of nearly 300 cubic miles a year. This possible, though not yet proven, gain would result even though immeasurable quantities of ice are carried outward from the glacial coasts in tabular icebergs, some of which are as big as the state of Connecticut. The principal effect of such transport is to maintain *status quo* by keeping the isolating and insulating ocean as cold as possible.

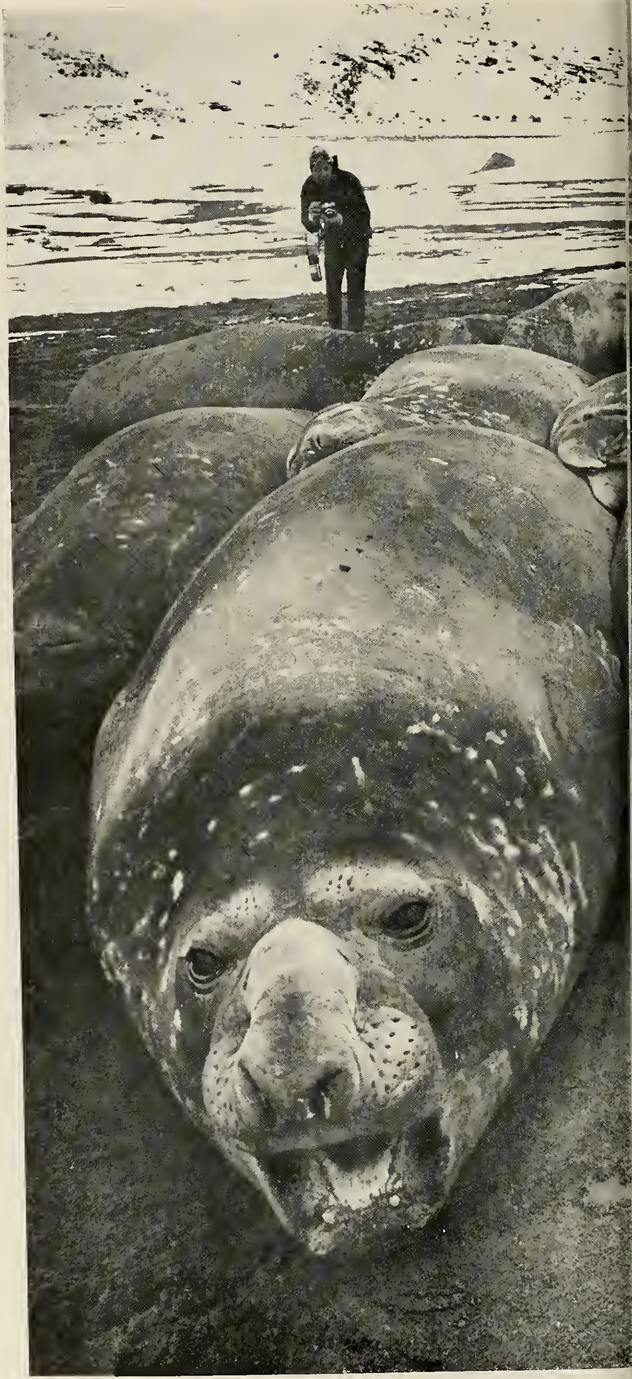
The respective differences between plant and animal life in the Arctic and the Antarctic are due, therefore, to the continental controls in the north and the isolation, insulation, and peripheral oceanic climate of the southern realm. In Antarctica we find no widely varied flora and fauna such as fill the lands around the North Pole. A hundred or more kinds of flowering plants thrive to the north of the Arctic Circle, whereas there are only two small and obscure species south of the Antarctic Circle. In spring the Arctic rings with birdsong. The land birds of Greenland include eagles, falcons, owls, ptarmigan, larks, wheatears, fieldfares, pipits, wagtails, redpolls, buntings, and ravens. The arctic mammals number lemmings, hares, ermines, foxes, wolves, bears, caribou, and musk-oxen. These—not to mention a counterpart of the Eskimo—are all missing from the south. The distinctions show us, as was long ago pointed out by Charles Darwin, that the periodic extreme temperatures of polar winter are less inimical to life than the unrelieved chill of antarctic, and even subantarctic, summer.

For food resources, the Antarctic claims the richest of all ocean waters, and despite the harsh climatic threshold, it has produced also a spectacular assemblage of life above sea level. Virtually all this life, however, subsists upon a food chain that extends from the sea. For higher animals, such as birds and mammals, there is no equivalent of the arctic food chains that stem from terrestrial vegetation. Antarctic life is manifest in enormous numbers of individual organisms. rather than in a wide range of kinds. The penguins, the hordes of flying seafowl, the seals of the drifting and the fast ice, the primitive yet highly specialized arthropods, the extraordinary invertebrates of pools that remain frozen except for a few days in each year, the lichens, mosses, and other cryptogamic plants—all are there to be investigated by the methods of many scientific disciplines.

We need all these life forms for ecological, behavioristic, physiological, sociological, medical, and many other reasons. We need them likewise for esthetic and humanistic ends. Since the Antarctic is the only fragment of the world that still seems unsuited to what we euphemistically call "development," let us keep it as we found it.

Nobody any longer doubts the importance of national parks, even though New Zealand is probably the only nation that has dedicated an adequate proportion of its territory toward such use. The Antarctic should properly be regarded as an international park, a concept that would harmonize with agreements already concluded among the countries that began joint exploration and research during the International Geophysical Year.

In 1964 twelve nations, which had earlier signed the Antarctic Treaty and subscribed to co-operative endeavor, ratified a list of "Agreed Measures for the Conserva-



The rapacity of skuas, which feed on penguin eggs and young or infirm penguins, has aroused some enmity among human visitors and workers in the Antarctic. But the much maligned skuas are indigenous elements of the native coastal ecosystem, unlike the man photographing the ponderous itinerant elephant seals or the increasingly numerous research stations along the Antarctic coasts and in the interior. Below, an Argentine research station huddles at an edge of the Antarctic Peninsula.

tion of Antarctic Fauna and Flora." This was an important step, even though the field was limited to land and water beyond 60° south latitude. This means that it does not cover the many islands to the north, along the Antarctic Convergence. Even more regrettable, it excludes whaling operations, which have long been the most shamefully shortsighted of overexploitations. More than 46,000 whales, a toll four or five times greater than the ocean population can safely endure, have been slaughtered in the Antarctic within a single season. Also, seals on high-seas ice receive no present protection under the "Agreed Measures." One seal, the crabeater, appears right now to be running the risk of a commercial threat. A list of specially protected species has, however. been drawn up, as well as a list of specially protected areas. But the official designation of these areas has been put off for further consideration. The document recognizes that protection of the limited vegetation, and of the great bulk of small animal organisms, can be achieved only through preservation of the habitat.

These slow-moving international intentions are commendable, as we all realize. But the representatives of the United States in Antarctica should on no account wait for their implementation. By precept and action it is up to us to make sure that the spirit of conservation prevails, most of all on the periphery of the continent, which harbors life for a hundred miles back from the sea.

This means that the pumping out of ships' bilges in coastal waters, and the ill-considered use of explosives, are no more tolerable in the Antarctic than elsewhere. It means that all resources are to be used only for truly cultural purposes. It means that life is never to be sacrificed for sport or "trophies." It means that colonies of penguins and other seabirds are never to be regarded as centers of amusement. We know too well that penguin populations decline if frequently and carelessly visited by groups of human beings, and especially if they are stampeded by helicopters. Even in the course of carefully controlled investigation of Adélie Penguins

What looks like the prodigious yawn of a sleepy elephant seal is actually the animal's threat display.

it has been learned that a bird seized and held briefly for banding may reveal the traumatic effect for a week thereafter, perhaps discontinuing the behavior appropriate for its reproductive stage, or failing to seek food in the sea at the normal time.

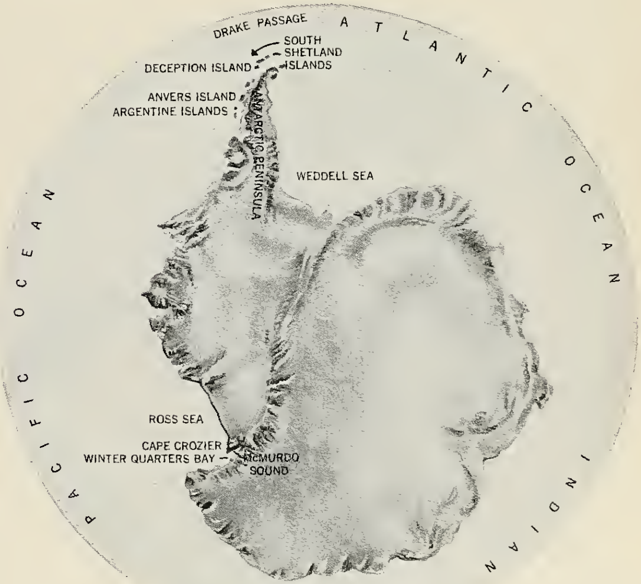
No one would want to deny workers at an antarctic station the privilege of watching penguins, but regulations should leave no doubt that the opportunity is a privilege, subject to necessary restrictions. Now that Antarctica seems inevitably destined to become an austral summer tourist realm, the point needs more stressing than ever before.

In short, a penguin colony cannot be a circus—not if it is to remain a penguin colony. Intentional damage, such as vandalism, is less to be feared than harm from well-intentioned trespass. Those who have spent patient weeks recording the seasonal cycle of breeding animals know this, to their sorrow. The same devoted researchers know likewise the murderous havoc that can and does result from heedless maneuvering of aircraft. At the Antarctic Symposium held at Buenos Aires in November, 1959, it was "conceded that each season the resupply operations in support of Antarctic scientific bases bring with them into the Antarctic a number of persons, members of ships' companies and others, who possess a minimum of interest in the natural life and its conservation and who, if not supervised and controlled, have made and will continue to cause serious damage to the flora and fauna."

And the time is past, except in emergencies, when we are entitled to rely upon antarctic resources for a significant proportion of station or shipboard food. Marine invertebrates and fish are perhaps an exception, but eggs and seals are not. Nobody need now complain because three hundred tons of seals were killed and cached as food for the sledge dogs of a former expedition. But today there are too many of us, coming too often, to warrant such a sacrifice. Let me quote from the minutes of the fourth meeting of the Special Committee on Antarctic Research, assembled at Cambridge in 1960. "In recent years the depredations of expeditions upon this traditional food source have become alarmingly heavy, and are now continued without respite from year to year. For example, near several stations the stocks of Weddell seals have been so disturbed that breeding rates have been affected and scientific research rendered difficult. Animals are killed without regard to age or sex, and even animals marked in the course of scientific studies have been taken. Without biological research it is impossible to assess the permissible annual crop which the various seal colonies would stand, but it is certain that this figure is being seriously exceeded in many areas."

We now have better use for the seals and, fortunately, decreasing need of the dogs. Dogs seem to me to pose one of the few threats of lasting contamination in the Antarctic. Rats, established for the better part of two centuries at some of the low-antarctic islands, are incapable of surviving in a feral state on the continent. Dogs, however, constitute a danger worthy of international consideration. There are rumors aplenty that parties from at least two co-operating countries have allowed their dogs to run free, with resulting butchery of penguins. No native antarctic animals are instinctively wary of terrestrial enemies. How could they be when they have never known them?

It is not absurdly unlikely that dogs might become acclimated in Antarctica and take on the role of arctic wolves. In February, 1958, the Japanese were forced to abandon fifteen Karafoto huskies when heavy ice prevented the relief vessel *Soya* from approaching their station, and a blizzard made recovery of the animals by helicopter out of the question. In the following spring, two of these dogs were found alive, and the information was headlined in Tokyo newspapers. The expedition leader radioed that when



the advance party landed, "Taro" and "Jiro" bounded forward, wagging their tails. It was assumed that the thirteen lost dogs had fallen into crevasses, had been rafted out to sea on ice, or had been devoured by the surviving huskies.

When Sir Vivian Fuchs came aboard U.S.S. *Glacier* off Marguerite Bay, in March, 1960, he told me that he had lost one of his sledge dogs near the base of the Antarctic Peninsula. Sixty days later the truant turned up again at the ship not simply in good condition but fat, after journeying 150 miles across the ice. Dogs and wolves are of the same genus. Huskies and wolves are as close in habitus as in heritage. It is horrifying and not wholly chimerical to picture wild dogs surviving, breeding, and multiplying on a winter diet of Emperor Penguins and a summer diet of Adélies—for as long as the birds lasted!

And what of other domestic or laboratory animals? The importation of poultry into Antarctica was stopped in July, 1966, but guinea pigs and mice are still called for. Such creatures could not become feral, but they might introduce parasites and viruses to infect the indigenous fauna. If experimental animals are necessary at national stations, provision should be made for their hermetic isolation and for incineration of their excreta and bedding.

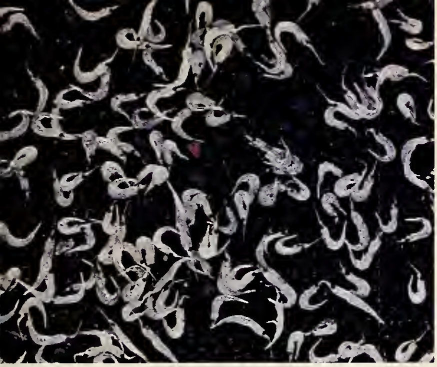
The transfer of contamination over long distances needs always to be kept in mind. No chlorinated hydrocarbons, so far as known, have been used within many hundreds of miles of Antarctica, yet Drs. Sladen and Reichel have recently detected residues of DDT in the tissues of Adélie Penguins and a crabeater seal from Cape Crozier. Other biologists have found the same substance in fish of the antarctic family Nototheniidae. Not one of these species ranges northward beyond the pack ice zone. The DDT was doubtless acquired by way of a marine food chain, and ultimately from creatures that ingested it thousands of miles away, perhaps in the Northern Hemisphere. Although the compound in the antarctic animals was in concentrations believed to be insignificant, the circumstances should still serve as a warning.

Few persons are free from prejudice, and prejudices spring as freely from altruistic motives as from any other. An example in Antarctica is the enmity that the skua arouses in the tender breasts of men who come in the ships and planes. Skuas devour penguin eggs. They miss no opportunity to steal, swallow whole, or tear to bits young penguins at any stage of growth. They hang around, ghoulishly, every adult penguin that shows signs of being ready to depart this life, and at the favorable moment they are quick to hasten its demise. (I may add that the presence of indignant human observers usually adds to the skua's chances of doing such mischief to "friendly" creatures.) From an objective point of view, this relationship between skua and penguin is neither to be condemned nor condoned. Penguins live on euphausid shrimps; skuas on penguins. So it has been, presumably, throughout the latter half of the Tertiary and ever since. To make it a moral issue by clubbing skuas and smashing their eggs is of no benefit to the penguins or to anything else. A childish desire to upset an ecological regime should have no place in anyone who is to head southward. We are down there to learn the ways of nature, not to reform them.

Many animals of the Arctic rear large broods of offspring. This is true, for example, of some of the northern ducks. Among mammals such as lemmings, the litters may furthermore number several in a season. A similar high rate of fertility is unknown in the Antarctic, where the fauna may be said to exist on a marginal basis of stability. Two additional influences tend to assure a low reproductive rate, namely, the uniquely severe summer environment, and the fact that all the air-breathing vertebrates take their exclusively animal food directly or indirectly from the sea.

Heavy snowfall, extreme frost, storms, or winds that merely close leads and clog coastal waters with tight pack are always likely to make prey inaccessible and thus, in the case of birds, block the feeding of the young. Scientific literature teems with instances of how heavily the hazards of weather are weighted against the egg and nestling stages of antarctic birds. Data from the life histories of Emperor Penguin and Snow Petrel suggest that an unsuccessful annual breeding cycle may be statistically more "normal" than one in which a single chick per pair of adults is reared to fledging and departure. At the Argentine Islands, off the western coast of the Antarctic Peninsula, Roberts found the mortality of Wilson's Petrel chicks to be about 65 per cent. The well-advertised carcasses of ancient, desiccated, chiefly immature seals at localities far inland show in like manner how tardy departure, or premature freezing and closure of sea ice, can lead to aimless scattering, starvation, and death.

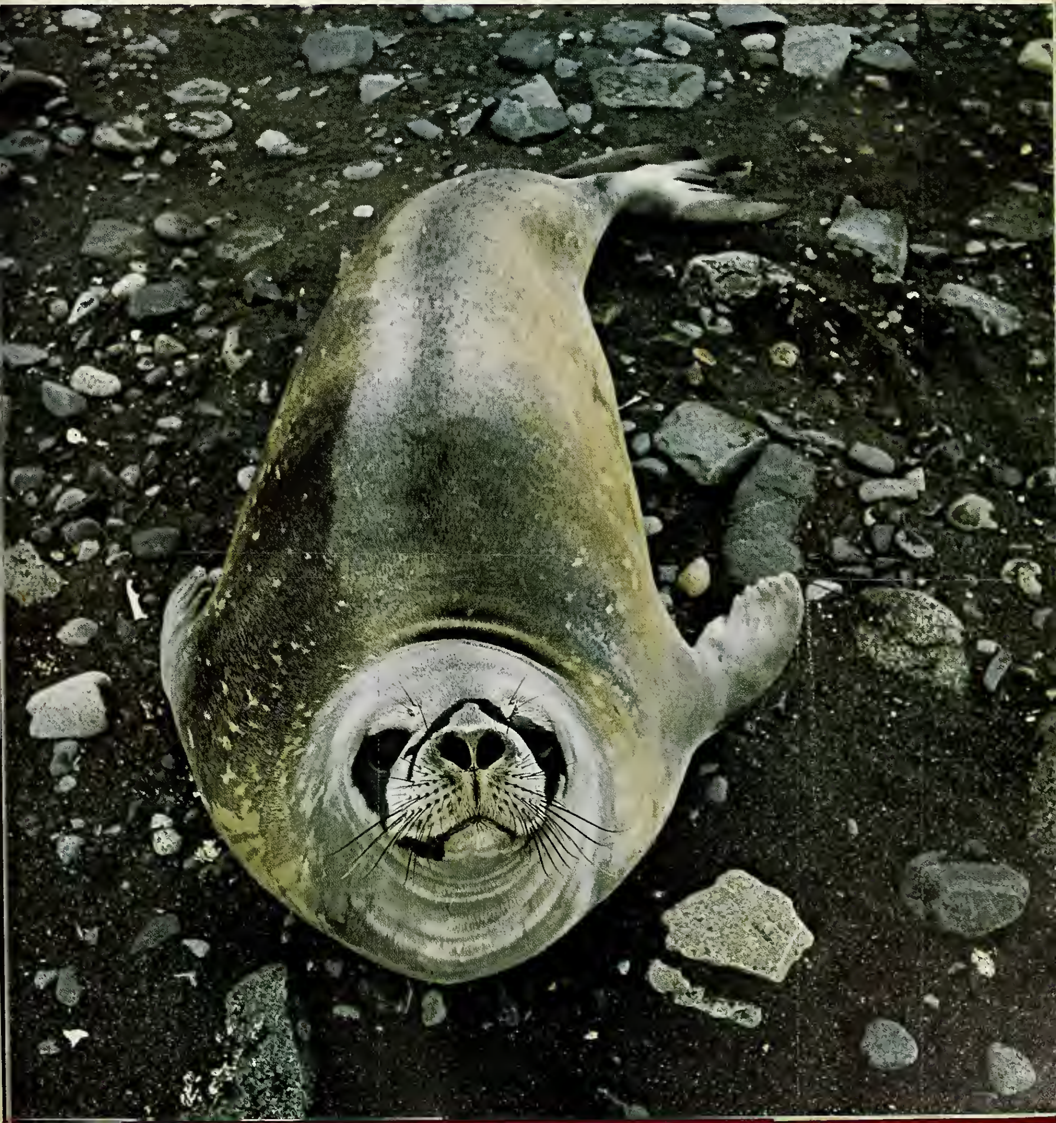
Other factors limiting exuberant multiplication include both disease and predators. The polar environment is regarded as singularly healthful, and yet we know that *Aspergillus*, a mold responsible for respiratory infections in birds, is liable to arrive with man's invasion,



color photographs by

GEORGE HOLTON

Euphausid shrimp—these had washed up on a Deception Island beach—are primary links in the exclusively marine food chain of the Antarctic. They feed on diatoms and are in turn fed upon by such higher forms as fish, birds, and mammals. The scurrying penguins at far left are Adélies. The Weddell seal, below, basks on a beach in the South Shetland Islands.



Exceedingly rare in the Antarctic, plant life is now accorded a measure of protection in the few places where it is found. In some areas, for example, it is illegal to walk on top of mosses. Sun-bleached whale bones, the bleak remnants of an abandoned whaling station, are scattered across a beach on Deception Island.

if it is not already there. Maladies grouped under the pathological term "ornithosis" sometimes take a heavy toll of bird life. Nor are the seals free from unpredictable holocausts. A report by Laws and Taylor describes mass deaths of crabeater seals during the season of the year that should be devoted to pupping. The mortality in a localized population of about 3,000 animals was estimated to be 85 per cent. The proximate cause was a highly contagious virus infection. It was limited in the area of its ravages and also extraordinarily host-specific. Weddell seals in the same vicinity, but dependent upon dissimilar food, remained healthy. The sickness of the crabeaters was probably induced by shortage of krill (euphausids), but going back to prior causes, the mortality was of climatic origin.

Mature antarctic animals are less prone to catastrophic destruction than are eggs and young. The limited data we have on longevity and viability indicate that most of the birds and mammals, once past their vulnerable infancy, enjoy a notably favorable life expectancy. No more convincing support for this opinion need be sought than the findings of Roberts in a west Antarctic colony of Wilson's Petrels. This author ringed nearly all the birds of 23 mated and nesting pairs. At the next breeding season, a year later, he recovered most of his marked petrels, linked with the identical mates and occupying the identical burrows of the previous year. In other words, there was no evidence of adult mortality among pelagic birds that, between reproductive periods, migrate far into middle latitudes of the Northern Hemisphere.

In such relative safety of adult antarctic animals we find an explanation of the very large numbers that some of their populations attain. Despite physical risks, predation by skuas, Giant Fulmars, leopard seals, killer whales, etc.. despite proportional scarcity of reproductive sites vis-à-vis the vast extent of watery pasturage, we encounter in Antarctica some of the most abundant of all species of birds, as well as seal populations estimated to number six million or more individuals of at least one of the six kinds. Why then, it would be fair to ask, has conservation of the antarctic fauna suddenly become a matter of growing concern?

*A sprinkling of black-backed Kelp Gulls (*Larus dominicanus*) adorns an iceberg that floats off the coast of Anvers Island.*

The answer is that in a long-isolated realm of tenuous balance, where broods are small (rarely more than a single annual replacement) and the dangers of immaturity extravagant, man, the new interloper, is the straw that can break the camel's back. We have seen the signs already in the overexploitation of Weddell seals in the neighborhoods of some stations. Around the periphery of the Antarctic, we have the appalling history of fur seal destruction—all but total—which is only now beginning to mend because of the half century of protection at South Georgia.

In the same outer oceanic ring of islands we note with foreboding that, although whales continue to decrease. the improved techniques of slaughter almost manage to maintain the scale of total return. The former, drastic wiping-out of the humpback has now been followed by similar extirpation of the blue whale stock. The percentage of blue whales in the Antarctic catch is today only a twentieth of what it was in 1930. The finback. last of the unprotected whalebone whales, is in turn paying the costs. There is nothing to follow except the sperm whale, which is once again being harried throughout the world's warmer oceans.

Man has himself become the center of a potential demographic crisis in Antarctica. Proliferation of his occupancy and travel must be accepted. There may be a modest withdrawal during some years. but it appears certain that the remainder of the twentieth century will be mostly years of expansion in his numbers, and that pursuit of scientific information will be the main reason for his presence.

An establishment like McMurdo, the home of a thousand or more human beings in the austral summer and of a couple of hundred in winter, fairly bursts with conservation problems, of which the disposal of sewage, garbage, and other waste is only the first. There is no subsoil seepage, no rapid bacterial decomposition, such as come to our aid in the more familiar world. Each season the biologists find that they must go farther afield for their ecological studies. Even the bottom of Winter Quarters Bay is losing the semblance of a "natural area."

With a dozen nations engaged in antarctic research, overcollecting of organisms and unwitting repetition of studies that call for collecting require weighing. Penguins, as preserved specimens or as captives for zoological parks, are much sought after by different groups at even single national bases. Fewer examples, especially of killed birds, might be made to serve the purposes of several or many workers. Sladen, Penney, Prévost, and others have recently conducted penguin investigations of great significance with negligible sacrifice of life and minimum disturbance of the colonies.

The task of perpetuating antarctic life calls for long vision no less than for immediate control measures. We are in need of scientific forecasts such as only patient and cautious study can supply. We cannot preserve without an understanding of the regime. Sound foresight may then prevent us from making the slight overdrafts on resources that differ only in degree from the gross overdrafts that we can already see. For whether we use many times too much or only a little too much of things we cannot create, the result will still be depletion. We are already wise enough to discard the fallacy that a species is in no danger because it is still common. We need always to recall and heed the brilliant maxim of Paul-Emile Victor, made at the Antarctic Symposium of 1960 in Paris, namely that Antarctica represents a system of immense capital, yet of only small annual increment. If we fail to acknowledge this, we may find that the ecosystem can be wrecked even more speedily than those of the temperate regions.

Life on the Sticky Sundew

An uncommon caterpillar flourishes in a bizarre niche—on the leaves of a carnivorous plant

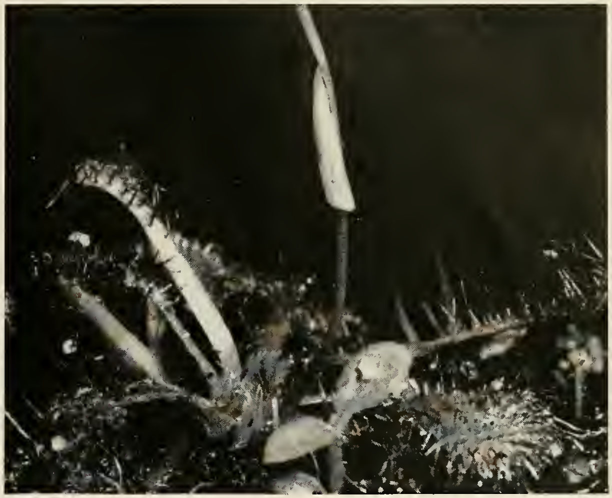
By Thomas Eisner

When an insect or other comparably small animal walks or flies onto a sundew plant, its death is virtually assured. The plant is carnivorous. The creature, on alighting, becomes entangled and trapped in a viscous, glandular glue and is unable to struggle free. Eventually, it succumbs, and before long its proteinaceous remains are digested by the plant. Appropriately known as sundews because of the glistening droplets of sticky secretion borne by the stalked glands on their leaves, these plants belong to the carnivorous genus *Drosera*. Their method of capturing prey is well known.

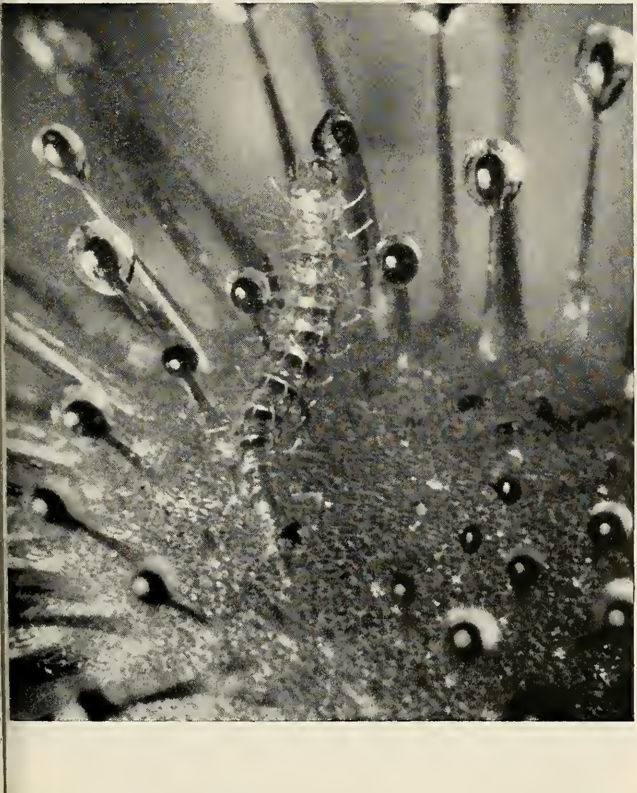
Unlike other plants, which commonly possess a multitude of insect enemies that feed upon them, sundews are remarkably free from insect attack. The glands evidently serve for defense as well as offense and act effectively to prevent herbivorous insects from consuming the leaves. But in nature, rules are rarely without exception, and the glands do not provide absolute protection. Some insects actually have the surprising ability to live and feed on sundew plants. One of these is the caterpillar of the moth *Trichoptilus parvulus*. I recently had occasion to study this animal, while staying at the Archbold Biological Station of The American Museum of Natural History near Lake Placid, Florida. A graduate student from Harvard, Julian Shepherd, collaborated with me.

We had transplanted some specimens of the southern sundew, *Drosera capillaris*, to the laboratory when we casually noticed one day that the glands at the center of some of the leaves had evidently been chewed away. Moreover, small pellets of what looked like fecal matter littered the surface of the leaves. An herbivorous insect was obviously responsible, but at first we could find it nowhere in the open. Only when we searched in the evening did we locate several of the caterpillars, which, by then, were foraging conspicuously on top of the leaves. Strictly nocturnal in their habits, the animals remain in hiding beneath the plants during the day and only emerge to feed after dusk.

Of the six specimens we found, four were already fully grown (5 mm. in length) and near pupation when first discovered. The other two, which initially measured only 1.5 mm. and had probably hatched within the previous day or two, were observed for the remaining eight days of their larval life. Since the animals are virtually oblivious to disturbance, we had no difficulty studying them. We simply trans-



The pupa of Trichoptilus, *above, is fastened to the floral stalk of a sundew plant. Below, a caterpillar imbibes the secretion at the tip of a gland. Note the caterpillar's bristles, which may act as "feelers" serving to prevent the animal from getting trapped by the adhesive, glandular secretion.*



ferred them, together with their plants, onto the stage of a stereomicroscope and then watched to see what they would do.

The principal food of the larvae, certainly of the younger ones, is the stalked gland itself. This is consumed almost in its entirety. First, the larva reaches upward and imbibes the droplet of secretion, then it eats the glandular knob, and finally it chews its way downward along the stalk. Only the very base of the stalk is occasionally left intact. It may take from ten to twenty minutes for a larva to eat a single gland. Having completed the job, it moves to feed on an adjacent gland. The entire central surface of a leaf may be denuded in a matter of hours. Oddly, the longer glands at the periphery of the leaf are either ignored or eaten last. This may have adaptive value, since the outer fringe of glands could effectively shield the larva against foraging ants or other small predators.

Older larvae also feed on glands, but they may, in addition, eat the blade of the leaf. By the end of eight days of captivity, one specimen had consumed several entire leaves and deglanded a number of others. To our surprise we found that the larvae will even consume the partially digested remains of insects trapped by the plant. This scavenging was observed twice, and in each case involved an older larva feeding on a dead staphylinid beetle of about its own size. No parts of the beetle were spared; even the thick skeletal capsules of head and thorax were completely consumed.

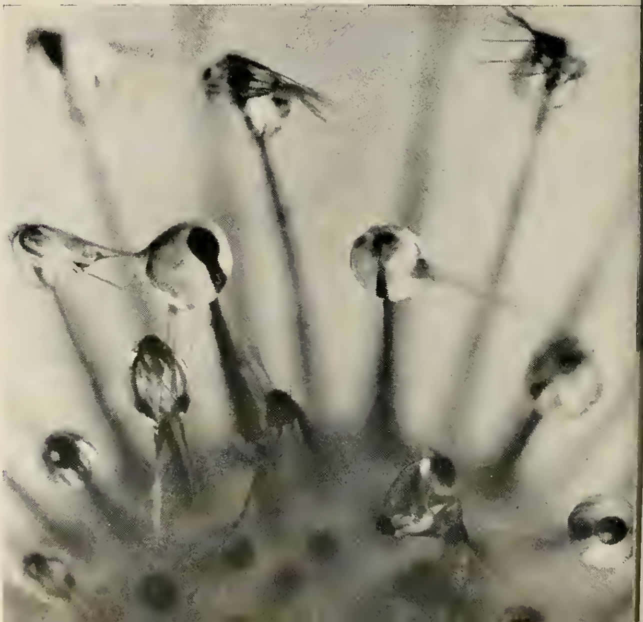
Although the larvae are ordinarily grayish brown in color, the overall hue varies with the nature of the gut contents, which are visible through the semitranslucent body wall. The younger larvae are usually reddish in color because they are replete with the intensely purple tissue of the glands and their stalks. Older larvae tend to be greenish, the color of the ingested leaf blade.

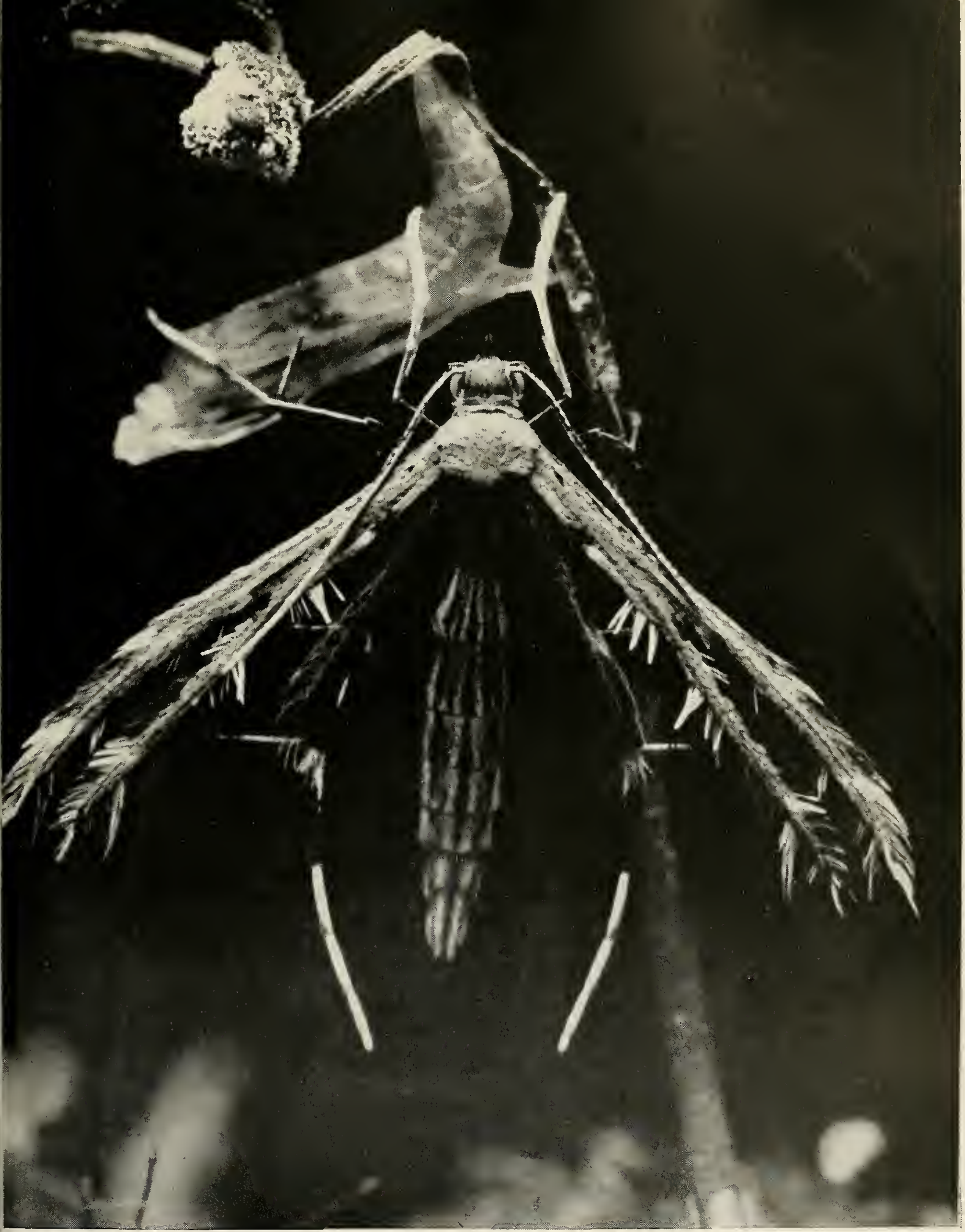
We were particularly curious to see how the larva avoids becoming trapped in the secretion. At first we thought that its integument was endowed with some peculiar non-adhesive properties, but this turned out not to be the case. When a small caterpillar was lifted with forceps onto a close cluster of glands, it stuck to the droplets and had to be extricated. We soon realized, however, that this was an unnatural sort of experiment since under normal circumstances the body of the larva hardly ever touches the secretion. The caterpillar's contact with the droplets is restricted to the tips of the long bristles that stick out from its body. This in no way impedes the animal, and the bristles are readily withdrawn from the droplets as the larva moves along. Whether the bristles actually serve to "feel" the presence of the droplets, thus enabling the larva to crawl among them with minimum risk of contact, is an intriguing possibility. Many insects are known to have special sensory cells at the base of bristles and do, in fact, use such bristles as feelers. Older caterpillars, by virtue of their larger size, cannot avoid occasional body contact with the secretion. However, they are stronger than the younger larvae and manage to break away without difficulty.

With one exception, involving a larva that pupated on a blade of grass, pupation always occurred near the tips of the long, upright floral stalks that grow from the center of the plant. This site is clearly an advantageous one, since the base of the stalk is protectively encircled by leaves and their glands. The pupae, which are light-green in color, hang head down from their abdominal tips. Adult emergence takes place ten to eleven days later. *Trichoptilus parvulus* is a member of the Pterophoridae, or "plume" moths. A fairly small representative of the family, it otherwise conforms to the typical appearance of members of the group. It had hitherto been caught only rarely. A few specimens from Florida and one from Louisiana were the only ones known to exist in collections.

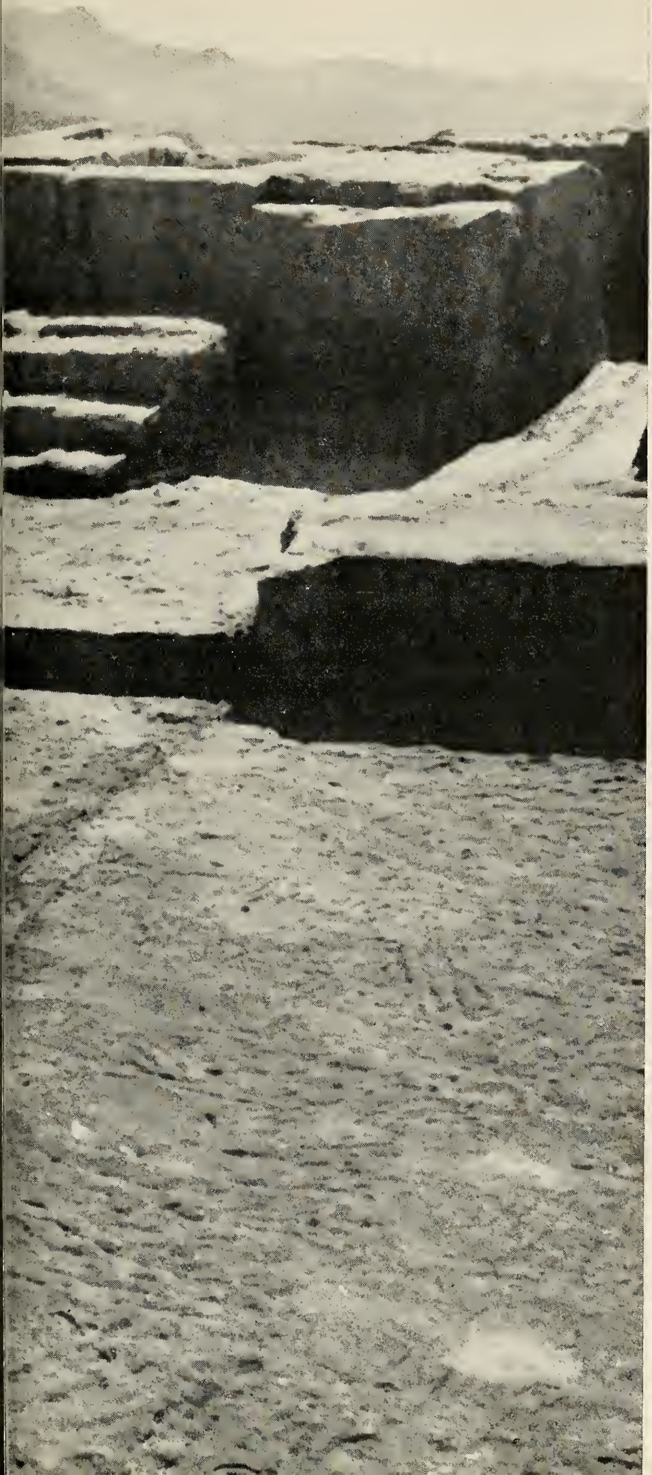
Although a number of insects are known to be associated with pitcher plants and other carnivorous species, very few live on sundews. A moth larva of the family Noctuidae has been reported to feed on them, but it apparently crawls only on the glandless portions of the plant. Certain Australian Hemiptera of the family Capsidae suck the juices of arthropods caught by sundews and are said to move about the leaves unhampered by the secretion. There are other species of the genus *Trichoptilus*, and at least one European representative feeds on sundews.

A good deal remains to be learned about the life cycle of *Trichoptilus*. One wonders how the female oviposits on a sundew plant without being trapped. She might, of course, avoid capture by laying her eggs beside the plant, rather than directly upon it. However, the possibility that she actually oviposits on the plant need not be ruled out. In a separate study we found that moths are among those insects least likely to be captured by sundews. The detachable scales with which moths are characteristically covered, and which are known to protect them against adhesion to spider webs (*see* NATURAL HISTORY, June-July, 1965), also prevent them from sticking to sundews. When a moth flutters into the plant, it simply loses some of its scales to the viscid secretion and then flies on. Adult *Trichoptilus* must therefore be capable of approaching sundews with at least some measure of impunity. Indeed, it is conceivable that a protective coating of scales was an essential preadaptation without which this particular moth could never have evolved its specialized association with the sundew plant.





The adult form of Trichoptilus, *above, has just emerged from the pupa. The feathery appearance of the wings is characteristic of the moths of this family (Pterophoridae) and accounts for their common name, plume moths. The "feathers" are detachable scales that protect moths against entrapment in sundew plants. At left, several glands and their secretions are beset with the wing scales from a plume moth that fluttered against them.*



Desert Waterworks of the Ancient Nabataeans

Two thousand years ago, a little-known people of the Near East dotted the landscape with a variety of devices for the control and conservation of the desert's most precious resource

by Philip C. Hammond

Out of the barren reaches of the southern Arabian Peninsula, sometime at the beginning of the fourth century B.C., swarmed a new people—bands of nomadic stockmen, miscellaneous collections of vaguely related tribes and clans—who in a period of three hundred years united to become the commercial barons of the entire Near East. The Nabatu, or Nabataeans, as they are called in classical sources, are first mentioned by Diodorus Siculus, who cites a skirmish with a Macedonian task force sent out by Antigonus in about 312 B.C. Diodorus described the Nabataeans as living in "many settled villages . . . a people beyond recount . . . with flocks and herds in numbers beyond belief." Between

The Great High Place, a cultic center equipped with cisterns, overlooks the Nabataean capital city of Petra.

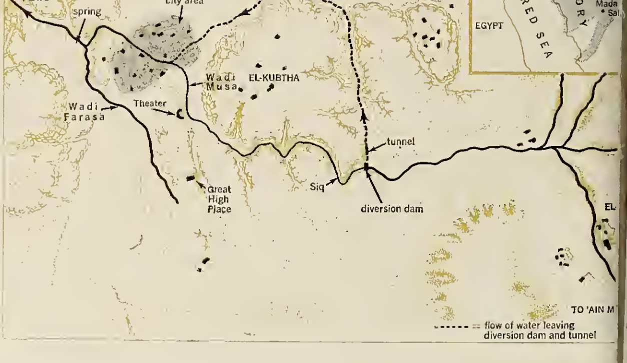
that time and the middle of the first century B.C., the Nabataeans had occupied Petra, the ancient capital of the Edomites, and had gained control of the bitumen industry of the Dead Sea and of the balsam groves of Jericho. Later, the historian Strabo (on the basis of data supplied to him by Athenodorus, Stoic philosopher and onetime native of Petra) pictures the Nabataeans as tightly knit under a monarchial government, assiduous in agriculture, builders in stone, and dealers in the luxury products of the ancient world. During their sudden rise from desert nomads to commercial imperialists, these people acquired a reputation as warlike expansionists and as meddlers in the affairs of their neighbors.

Throughout this era, the Nabataeans developed a phenomenal hydraulic ability, manifested in numerous water control systems that have outlived their creators. Prior to identification of their pottery some thirty years ago, by George Horsfield, Chief Curator of Antiquities of Transjordan, the Nabataeans remained obscure as a distinct culture. All that was known of this nation was obtained through casual literary references. Strangely enough, the extensive waterworks constructed by the Nabataeans were not linked to them and instead were thought to be the product of the Byzantines. But with Horsfield's findings came the ability to identify Nabataean sites and hydraulic installations. This knowledge, combined with further research by the author, has made it possible to trace Nabataean hydraulic skill outside of their capital at Petra. It is now possible to recognize as Nabataean more than a thousand installations, extending from Mada'in Salih in Saudi Arabia to Damascus in Syria, and stretching eastward from the coast of southern Palestine deep into the desert wastes. The rock-carved remains of Nabatene's capital, along with the lesser-known site of Mada'in Salih, have long attested to the Nabataean's skill in stone carving. Eventually, in a land of high cliffs and deep fissures, as well as desert wastes, the stonecutter became the engineer's ally, and the abilities formerly devoted to tomb façades and sculpture were diverted to the production of runnels, diversion channels, cisterns, and othe water control systems.

By the first century B.C., the Nab taeans had secured the overlan access routes of the world's riche shipping, and had extended the commercial power over all of sout ern Syro-Palestine. On the long trai of the Sinaitic peninsula and i northern Arabia they functioned caravaneers, guiding their own an other people's caravans through t waterless reaches. On the coast the served as middlemen, dealers for t shipping of goods by sea. Inland the north, their outposts provide way stations and depots for overla transportation. Petra was the poli cal and commercial center, fro whose fastness the trade routes led every direction to move such luxu products as copper, iron, purple r ment, embossed work, painting molded images, spices, bitumen, b sam, frankincense, and myrrh.

To control and maintain this e pire, outposts, villages, and shippi centers, which provided facilities f the provisioning of the caravan were established. These had to be f and watered. At the same time, Pet became increasingly urbanized a her facilities more sophisticated,

Many cisterns, cut from rock or fashioned with mortared masonry, were built by the ancient Nabataeans. Some are still capable of holding water.



did those of the larger Nabataean centers elsewhere. This tendency toward urbanization and increased population densities necessitated advances in hydraulic undertakings.

Furthermore, the commercial need for outposts demanded that food production in outlying areas be increased and that the best use be made of available water resources. In the occasional oasis, this resulted in implementation of the natural springs by means of wells, overflow cisterns, runnels, and flow channels. In these sites, stonework was improved by the addition of cement and concrete to the earlier plaster finishes of crude-burned limestone and charcoal.

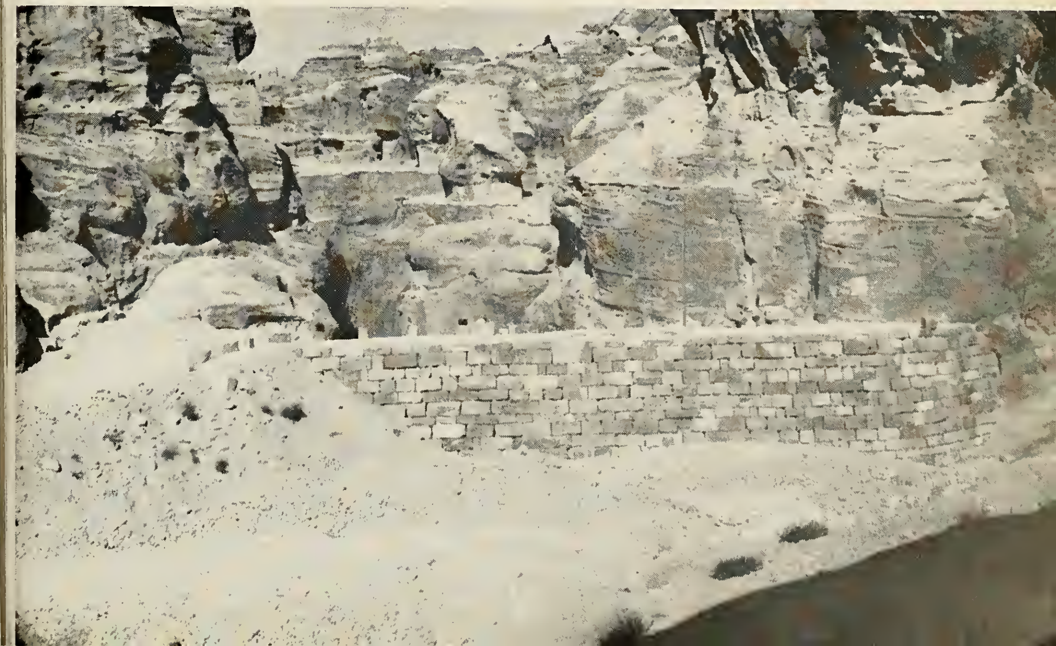
But in most of Nabatene, water was not a perennial affair, even if trade was. As a consequence, in the near desert areas, simple implementation of existing flow was not possible. However, nomad ingenuity, together with an ancient heritage of water searching and a rapidly improving technology, furnished a variety of solutions to the problem of providing water in the desert.

Terracing, for instance, slowed the runoff of rainfall, and as the water seeped from one level to another, vineyards and groves planted on the terraces retained moisture while providing fruit and shade. Even today, the remnants of Nabataean terrace farms are visible, with El-Ji, just outside Petra, a prime example. In areas where deep ravines had been eroded into the sandy soils, another approach was utilized, that of blocking wadi (channel) mouths with seepage dams, thereby cutting down the force, and loss, of the torrential flows that raced down the narrow defiles during the rainy season. Wadi farming became widespread, as the number of such little dams and barriers indicates.

In mountainous areas, where cliffs of sheer stone dotted the landscape, fall-off points in the cliffs were enlarged, natural basins below the cliffs were dammed, and artificial catchments were carved from the bedrock. The inevitable plaster sealed these installations, and where natural shade could not assist in slowing down evaporation, trees appear to have been planted for that purpose. At the top of the cliffs, high above the catchments, one can still find runnels, often merely crude channels hacked out of the rock, meandering to the wider, waterworn rim of a natural fall-point. Today, most of the catchment basins are choked with weeds and other vegetation, attesting that the system worked.

Deeper within the desert, where both wadi and cliff fall are absent, still another means was used to trap the precious rainfall of the wet season. There, huge, rectangular cisterns were hewn out of the bedrock or built of mortared masonry. In spite of evaporation losses, which must have been tremendous, one can still find the water-filled (and now generally debris-clogged) cisterns of the Nabataeans. Centuries of neglect have only diminished their capacity, not their basic worth. Some of these were probably filled, during the dry season, to accommodate desert caravans. Water could be brought to the cisterns from perennial springs at some distance by aqueduct or camel-back, insuring a year-round supply, and some were actually connected by channels to such springs in the neighborhood. Wells were also used, as Diodorus notes in his account of the cunning shown by the Nabataeans living in the desert areas.

In most cases, the Nabataean hydraulic engineers applied a number



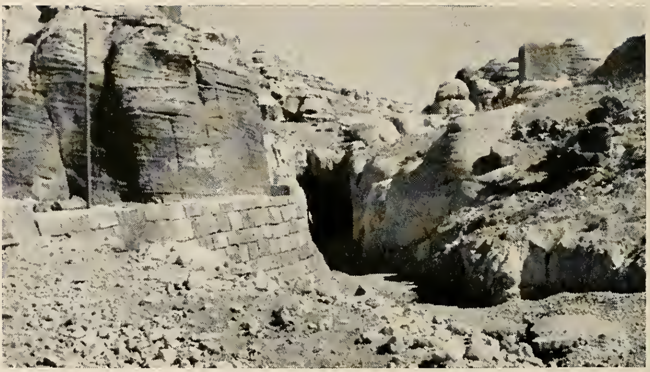
The essential features of original Nabataean construction are preserved in this rebuilt dam, which protects the gorge, or Siq, leading into Petra.

of these individual solutions to a single problem. Thus at Wadi 'Ain Qudeirat, in the Negev, not far from Petra, they used a system of diversion walls, an aqueduct from a perennial spring source, cisterns, and a 27-foot-square reservoir, relying on gravity feed to keep the system operating. At Petra, likewise, such multiple installations are much in evidence. These, in combination with dry farming agronomics, learned by sheer trial and error, permitted clustered sedentary settlement. Surface exploration indicates that virtually none of the sites in the semiarid regions of the Negev and southern Transjordania were occupied prior to the Nabataean period (Lawrence's "Byzantine" sites are generally Nabataean), and that deterioration of the systems took place relatively soon after the political downfall of the Nabataeans, beginning in A.D. 106.

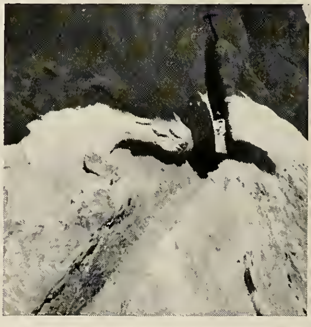
A final means of water control in these areas is the strangest encountered in either hydraulic engineering or Nabataean history. This is the use of the so-called *teleilat el-'anab* ("hillocks for grapes"). Scattered throughout Nabataean semiarid areas are slopes covered by rows of these small stone piles, or hillocks, sometimes numbering in the hundreds, whose exact purpose—and effect—still baffles hydrologists. Building on local folklore and etymology, some scholars in the field see them as deflection systems, channeling water to the cultivable areas lower down the slopes. In support of this argument, Dr. Nelson Glueck, a leading authority on Nabataean culture, offers air photographs, showing the resultant channels carved by rainwaters—the most likely explanation offered thus far.

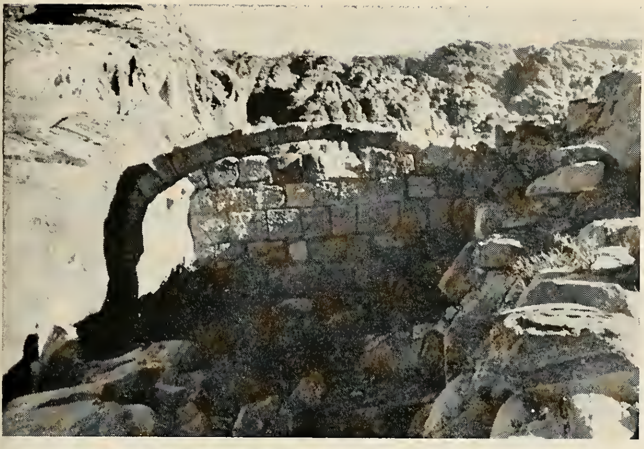
In Petra and other urban areas, the problems of water control were complicated. More water was required than was necessary for either nomadic or open village living, yet at the same time, the urban concentration of dwellings, public buildings, streets, and other fixed installations required controls against too much water in the wrong place. Petra presented a unique problem of water control because of its physical location. Entrance to the city was primarily through a narrow defile, known as the Siq, that twists and turns through the eastern ridge, which seals off the site on that side. The Siq then broadens out to a comparatively wide area (the Inner Siq) before opening into the valley proper where the ancient city was located. Its bed within the city is a true wadi (Wadi Musa, "The Valley of Moses"), a relatively narrow water channel meandering between low, sandy hills on each side, finally moving into an exit cut through the western city ridge, and emptying over precipitous drops to the level of the Negev flats. Nine months of the year the Siq system was passable and completely safe. During the rainy season, however, the whole system could erupt into a wild torrent bed.

Fed by ground waters to the east, as well as by hundreds of natural spillways on each side of the eastern ridge, the channel could easily be flooded by water crashing into the Inner Siq and spreading over the banks of the central urban wadi, backing up there because of the narrowness of the exit passage. Occasional photographs of the Wadi Musa in torrent have been taken in modern times, illustrating the problem that existed before the reinstallation of flood controls (the original controls fell into decay with the end of the Nabataean-Byzantine settlement of the area). Most tragically spectacular was the torrent buildup that engulfed a party of French tourists not many years ago. Over thirty were drowned by a forty-five-foot sheet of water from a flash flood, which filled


Flood waters leave the rebuilt barrage dam, enter a rock-hewn tunnel (in background), and then flow harmlessly through channels into the city proper.

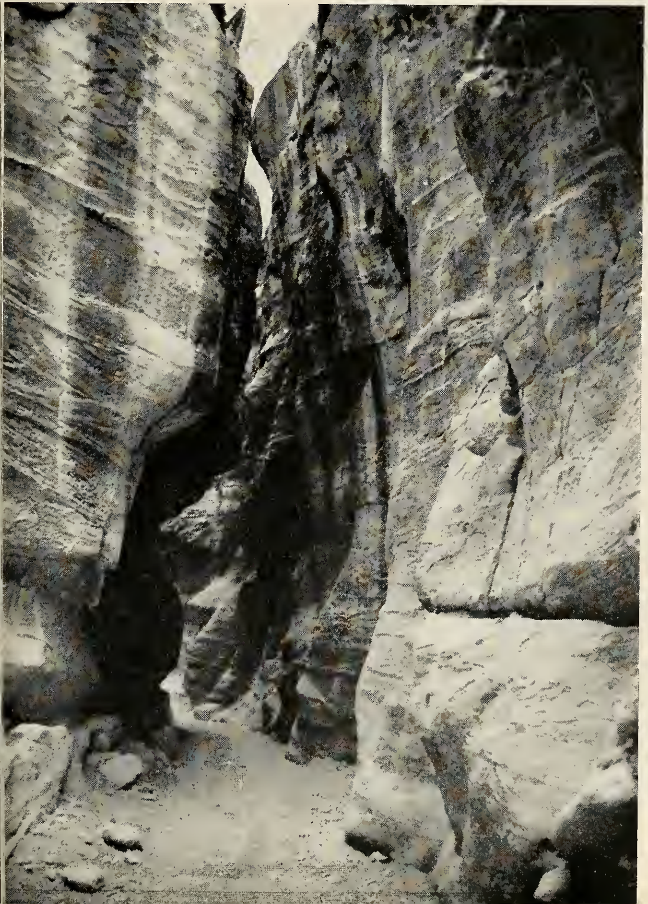
Open canal (top of photo), built during Roman occupation, replaced more elaborate systems of ceramic pressure pipes constructed by the Nabataeans.


Channels and ceramic pipes, located in the sides of the Siq, were part of a system that led water into Petra from a perennial spring outside the city.



Part of Petra's water-supply system included stone arches that carried pipes over gorges and across the rough surface of the El-Kubtha ridge.

The rocky defile, or Siq, serves as an entrance into Petra. Before the barrage dam was reconstructed, flash floods occasionally filled the narrow chasm.



the Siq itself and overwhelmed the party, carrying the bodies of the unfortunate victims out into the city area and even into the exit wadi itself. This accident prompted the then director of the U.S. Water Control Mission, Mr. Oliver Fulsom, to reconstruct the essential features of the ancient control system of the Nabataeans to insure tourist safety. This involved clearing the debris-clogged channel outside the Siq, which leads to an ancient diversion tunnel, and completely rebuilding a barrage dam at the mouth of the Siq. This system now stands very much as it was in Nabataean times, and is a tribute to Nabataean hydraulic engineering. The season following reconstruction, a flash flood (expediently prompt for testing purposes) pounded harmlessly against the barrage dam, and then tamely followed the ancient channels to wear itself out in the precipitous gorges of the eastern ridge, before it dropped again into the Nabataean control lines leading back inside the city. Additional refurbishment of the erosion control walls of those channels has since been done, making the city safe for tourism, and preserving the archeological treasures of the still-unexcavated city from further destruction.

In ancient times, this particular control system was a great deal more elaborate and appears also to have been a part of the answer to supplying water to the city, as well as controlling its periodic superfluity. An aqueduct led from 'Ain Musa, a perennial spring of rather major size four or five miles from the city. When it reached the eastern Kubtha ridge, it was carried by arches over the Siq entrance to covered cisterns cut into the bedrock of the mountain. In conjunction with it, a system of large, interlocking ceramic pipes led along the Siq wall and around the city proper. Neither the date nor the exact extent of this system has yet been thoroughly investigated, but on the basis of my excavations in 1961 and 1962, one phase of it may reasonably be dated to the reign of Aretas IV (9 B.C.—A.D. 40) or earlier. The remains in the Siq walls, where the pipes were carried by canals cut into the rock, are badly damaged, but still recognizable. The aqueduct arch over the Siq fell late in the last century, but not before sketches were made of it. Across the mouth of the Siq, as was noted above, the heavy barrage dam served both water control and military purposes, effectively sealing off Petra's front door. The length of the Siq was protected, to some degree, by rock-cut runnels leading into the cisterns on El-Kubtha and probably by natural spillway dams.

In front of the barrage dam, flood waters were channeled into the mouth of a rock-cut tunnel, about ten feet square and one-quarter mile long, leading to natural ravine channels in the heart of El-Kubtha ridge. These ultimately opened into natural wadi beds inside the city, whose sides were protected against erosion by dams. When the flow reached the bed of Wadi Musa in the center of the city area, further diversion, channel, and erosion control walls kept it in check. The extent of this control may be seen from the height of the platforms on either side of the wadi bed in front of the temple called Qasr Bint Far'un. Although the bridge that once joined the two parts of the city over the wadi is gone, the height of the remains above the present bed indicates that the torrent height was minimal, as long as the system was in operation.

Petra's Main Theater, estimated to have seated some 6.000 to 8.000 people, utilized a number of systems to prevent it from flooding as a result of both rainfall and ground spill. Since it was cut into the face of a cliff, with some forty-five feet of solid rock face behind it, natural spill all around its orchestra arc was considerable, not to mention the buildup of water within the basin of the auditorium, as a whole. A wide rock-cut channel bounded the upper gallery of the uppermost seating rows, connected to runnels and spillways outside the complex. The walkways between seating sections were likewise protected by rock-cut canals leading outside. The topmost of these had only simple spillways cut diagonally through its outer edge, rather than well-cut drains. Such a jerry-built solution reflects the class structure of the provincial theater—modeled after the Imperial Roman type—since only women and children used the inferior upper seating area.

The orchestra floor was plastered, thus sealing in any collected water, but was sloped downward at an angle of about 2.5 degrees. with runnels cut into the stage front, draining off into substage areas. The stage floor was porous enough to permit general drainage, except where it was laid directly on bedrock. In the latter case, subfloor runnels were cut into the rock surface.

Related to the Theater complex was a series of pressure-pipe and canal drains situated in front of it. Stages of repair are evident here, with two distinct consecutive pressure-pipe systems followed by a rectangular canal system. The first two, stratigraphically. are Nabataean, with the less elaborate canals stemming from the Roman period of occupation at Petra following A.D. 106. Hence the Theater, as well as the Siq, shows a conscious, intricately planned, and technically well-executed water control effort.

The rise in sedentary population, plus the tremendous influx of commercial and other transients, created the problem of coping with water scarcity. Here, the desert heritage, the remarkable stonecutting skill, and the urgencies of commercial exploitation forced the development of conservation measures on a grand scale. Again, more than one solution was often applied.

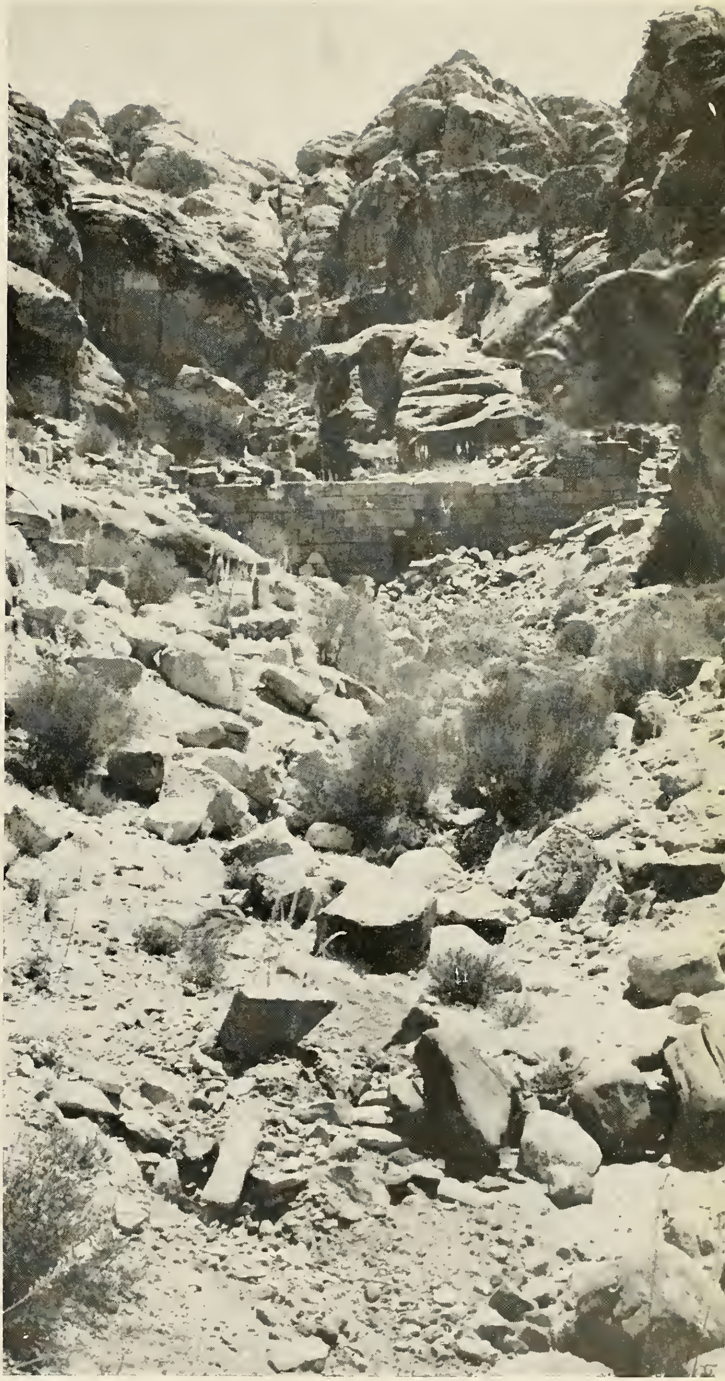
In the agricultural suburb of El-Ji, terracing was the primary device used, and the agricultural richness of that suburb even today indicates the thoroughness with which the method was employed. Even where the modern area is fallow, local plant life abounds, growing wild in great profusion and marking the site by its striking greenness in the midst of the tan, rocky landscape.

Mention has been made of the piping system leading from the spring, 'Ain Musa, whose remains are no longer fully traceable. The spring still flows at an extraordinary rate and supplies the local area with stock water. as well as a drinking supply. Likewise, the aqueducts, leading the pipes over natural breaks into the city, are now only piles of stone, but the stubs of their imposts, often set into bedrock, are still visible, especially over the mouth of the Siq. The arched covers of the great rock-hewn cisterns on El-Kubtha have similarly fallen in, to choke the reservoirs with debris. However, even in such condition. greenery is still found growing within them, indicating that the plaster that originally sealed them still adheres to some degree, after nearly two millennia. Other, less elaborate but equally large cisterns may also be found spread around the site. Most spectacular is the one on the western slope of El-Mudbah, on whose top rests the Great High Place, an ancient cultic center. On the top of the same mountain may be seen water conservation systems connected with the Nabataean cult, in the shape of smaller cisterns that constantly supplied water for religious purposes.

Cisterns also occur near some of the smaller springs, closer to the city site, in Wadi Abu 'Ollegha and Wadi Siagha. In the latter case, the perennial spring is still strong enough to provide Petra's only "stream"—a rather weak specimen today, but one that once supplied a copious daily flow, as still shown by the partially ruined dam and storage basin at one point along it. In both these spring-watered areas, oleander and other thicket growth is lush. The extent to which cisterns were utilized in antiquity, aside from the reservoirs noted, cannot be determined with certainty. In Wadi Siagha, at least, an aquiclude runs not far beneath the surface, so that the whole defile could have been put to use for garden farming, as well as for drinking and other water needs. Judging from the size of piping used in this system (nine inches in diameter, with walls almost one-half inch thick) the flow rate into the city would have been enormous, if the supply fed full capacity and flowed without interruption. Since gravity feed was employed, however, this potential volume rate would not have reached its maximum strength in normal usage.

Only limited farming appears to have been carried on inside Petra's valley limits, and no distinctly agricultural installations seem to exist. Thus the major need for water was household and industrial, with food production decentralized to the richer slopes outside the Siq. Some dry farming could well have taken place near the city, however, without visible remains present on the modern surface. Large stretches of flatand, watered naturally by the cliff spills, as well as the hill slopes, could have produced fairly substantial crops. Even though no agricultural ools have been uncovered in excavaions to date, this does not preclude such garden farming, since wooden plows and non-metallic threshing and harvesting tools could have been used, and these would have decayed, eaving no remains.

The modern water control and conservation programs of the Syro-Palestinian area owe a debt to the ancient Nabataeans. As population ncreases began to be felt in the modern areas once under Nabataean conrol, water engineers and geologists began to seek additional sources. After the initial surprise that wherver water was found, fragraments of Nabataean pottery were always presnt, conservationists began to reerse the order of their inquiry and look for the latter first. Often hidden beneath the debris of centuries, Nabtaean hydraulic installations someimes escape casual search, even on scientific basis. But wherever the Nabataeans settled, their pottery remains are found—and water, in some orm, is not far off. Some of the systems have been put back into modern se by simple clearing of debris and eplastering; other, more complex ystems need modern modification; ome are, of course, too rudimentary for modern needs. All, in some way, owever, provide data for possible esettlement of areas that outwardly ppear to be inhospitable. In the Negev, especially, considerable use as been made of the Nabataean herage of desert farming. In trans-Joranic Jordan, ancient installations ave also been reopened, or re-estabshed to accommodate tourists. Thus is that out of the dusty past a helping hand has been stretched by the Nabataean desert engineers in aid of heir modern counterparts.



ainfall and cliff drainage collected ehind this dam at El-Barid and served s a water supply for caravans.

SKY REPORTER

The future authors of *A Guide to the Natural History of Mars* (to be reviewed in this journal early in 1974) are depending on astronomers to do a lot between now and then.

In six years the Voyager will reach Mars and parachute a capsule of biological instruments to the surface. We then hope to learn, finally, whether there is life there after all. But first we must learn enough to insure that the Voyager capsule is designed properly. Until we are more certain of conditions on Mars, we will not know what kind of life to look for.

Advances in ground-based instrumentation have raised new questions. Are the polar caps made of frozen water or frozen carbon dioxide? Are the dark regions higher or lower than the bright regions? Are there substantial quantities of water beneath the Martian surface, and does this affect the surface?

Mars reached opposition in April—it came within 56 million miles of the earth. Earlier, 120 scientists had gathered in New York to compare notes and to plan new experiments. One of them, Dr. Gerard de Vaucouleurs of the University of Texas, said he welcomed all the theories presented because they spur research, but that an observer "knows too many facts to accept a hypothesis."

According to De Vaucouleurs, almost nothing is known about the dark regions of Mars. They are really interspersed with nodules of bright material, and the light from these dominates any observation. We do not even know the real color of the dark areas.

The French-born astronomer, reporting on the Mars mapping project he is directing, said that existing maps are too contrasty and too schematic and do not indicate the gradations between light and dark areas. The lines are too straight, and our maps are not yet good enough to land a capsule within 400 miles of a target.

Mars is now receding from the earth, and will return to opposition only twice more before 1973. This will occur in 1969 and again in 1971.

PROSPECTS FOR VENUS

Exobiologists have been encouraged to concentrate on Mars in this decade, but it is beginning to appear that Venus may not be so dry or so hot as was believed.

The first ground-based observations of water vapor in the Venusian atmosphere have been reported in the *Astrophysical Journal*. Groups at Kitt Peak in Arizona and at the Lick Observatory in California have obtained spectrograms of water vapor above the clouds of Venus.

The Kitt Peak group found the equivalent of a 125-micron layer of water above the clouds. The Lick groups estimated the water density as the equivalent of 60 microns. These are not deluge conditions, of course, a micron being 1/25,000 of an inch; but it does confirm that there is water.

Until about 1956, Venus was thought to have surface temperatures comparable to earth's. Then microwave studies, seemingly confirmed by the Mariner probe in 1962, indicated a surface temperature near 800° F. This is far too high for the molecules necessary for life.

Chemists at Rensselaer Polytechnic Institute, however, have reported in the *Journal of Geophysical Research* that chemical reactions in the atmosphere of Venus may account for part of this intense radiation. Electric discharges in the atmosphere, a product of the reaction, could account for intense radio bursts and also for the faint glow sometimes observed on the dark portion of the planet.

If some of the microwave radiation does originate in this way, then the surface temperature may be several hundred degrees lower than 800° F.

AMATEUR ASTRONOMERS TO MEET

Amateur astronomers from across the country will meet in Washington, D. C., during the long July 4 weekend for the 1967 Astronomical League convention. Meetings will be held at Georgetown University. Side trips will be made to the Naval Observatory and the Goddard Space Flight Center.

The Astronomical League is a federation of amateur clubs and individual members. For convention information write G. R. Wright, 202 Piping Rock Drive, Silver Spring, Md. 20904. *John P. Wiley, Jr.*

CELESTIAL EVENTS

Bright planets continue to dominate the early evening sky, as do the three bright stars of the Summer Triangle, Altair, Deneb, and Vega, rising in the northeast early at night. Venus and Jupiter appear in the sunset glow and set soon after dark. Mars, in the south near Spica, sets about midnight.

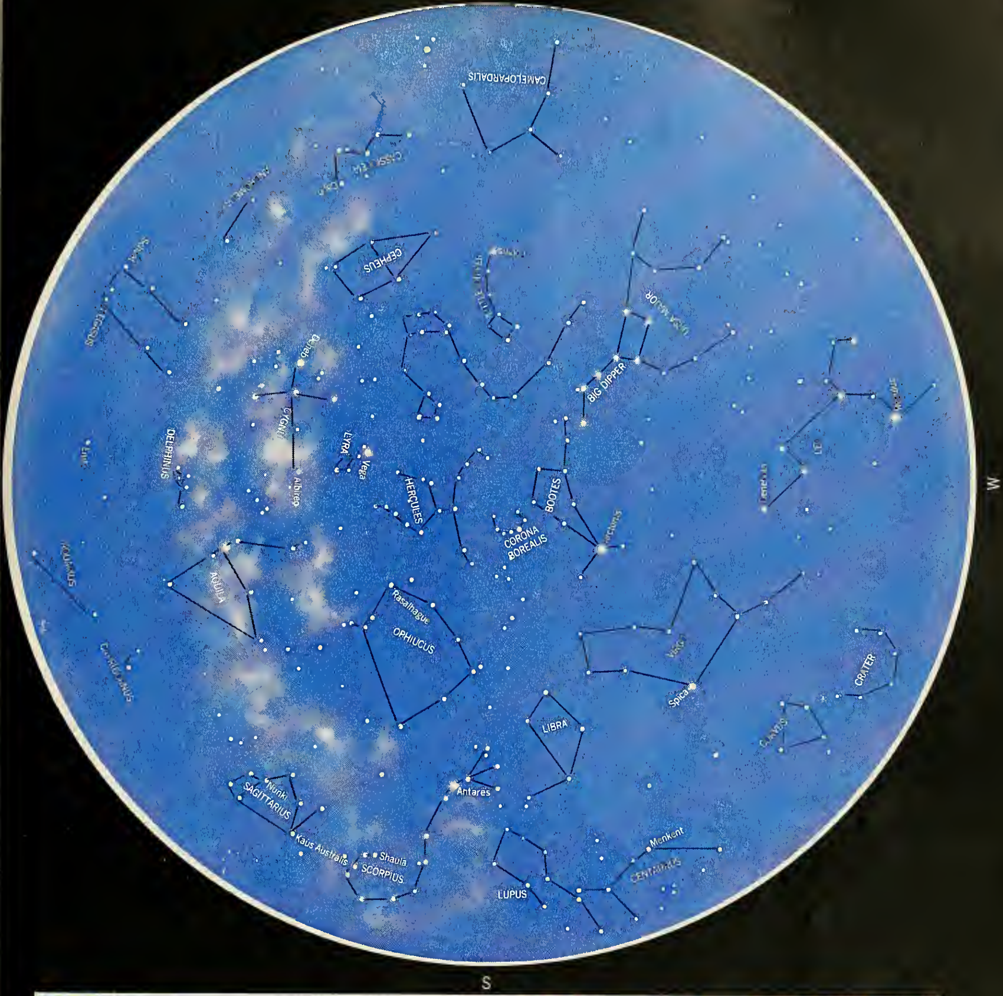
Until June 8, when they are in conjunction, Venus is to the right of and below Jupiter; after that to the left and above; and it is always the brighter of the two. The crescent moon will be near the two planets on June 10, 11, and 12, and again on July 9 and 10. Venus reaches greatest easterly elongation on June 20, and is most brilliant as an evening star on July 24. By late July, Jupiter and Venus will be well separated.

Saturn is visible from about midnight on as it moves from east to south. Mercury may be seen low in the west before sunset during mid-June, and in the east before sunrise in late July.

The sun reaches the summer solstice on June 21 at 9:23 P.M., EST, when summer begins in the Northern Hemisphere. The Delta Aquarid meteors reach maximum on July 29, although meteors can be seen for a week or so before and after maximum.

Thomas D. Nicholson

Hold the star map so the compass direction you face is at the bottom; then match the lower stars with those in the sky. The celestial events chart shows times of rising and setting of the sun, moon, and principal planets; times of twilight; and sundial correction during the month. Horizontal scale shows time; vertical shows dates. The top strip locates bright stars, planets, and the moon within the zodiac. The horizontal scale of hours shows time when objects are due south and highest at midmonth and at significant phases of the moon.


CAMELOPARDALIS
CASSIOPEIA
CEPHEUS
URSA MINOR
URSA MAJOR
BIG DIPPER
Deneb
CYGNUS
Albireo
LYRA
Vega
DELPHINUS
Enif
HERCULES
CORONA BOREALIS
BOOTES
Arcturus
LEO
Denebola
Regulus
AQUILA
AQUARIUS
CAPRICORNUS
Rasalhague
OPHIUCUS
VIRGO
Spica
CRATER
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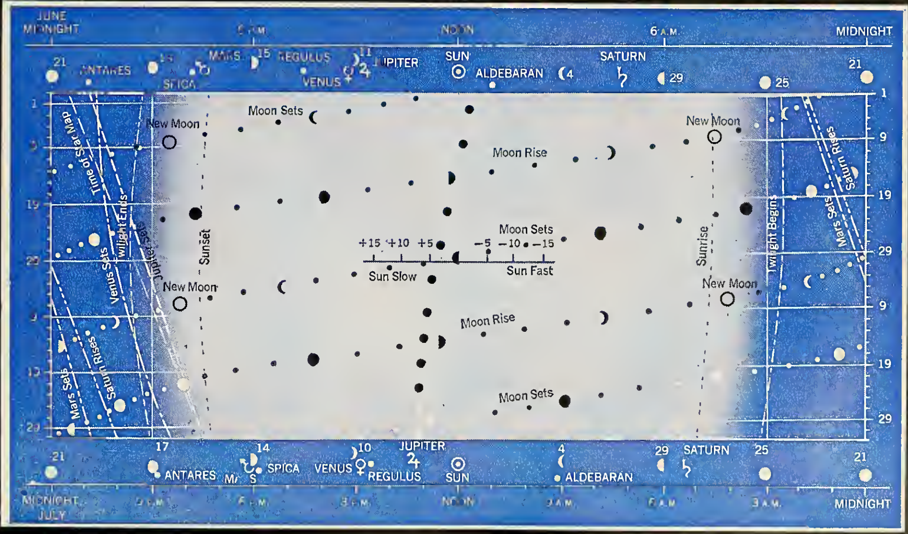
JUNE
MIDNIGHT
6 P.M.
NOON
6 A.M.
MIDNIGHT
21
ANTARES
15
SPICA
MARS
15
REGULUS
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VENUS
JUPITER
SUN
ALDEBARAN
4
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25
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19
29
Time of Star Map
Twilight Ends
Venus Sets
Jupiter Sets
Mars Sets
Saturn Rises
Sunset
New Moon
Moon Sets
Moon Rise
Moon Sets
New Moon
Moon Rise
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+10
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−15
Sun Slow
Sun Fast
Sunrise
New Moon
New Moon
Twilight Begins
Mars Sets
Saturn Rises
21
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ANTARES
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SPICA
MARS
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VENUS
REGULUS
JUPITER
SUN
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ALDEBARAN
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JULY
9 P.M.
6 P.M.
3 P.M.
NOON
9 A.M.
6 A.M.
3 A.M.
MIDNIGHT

Photographs by MARC RIBOUD

NOMADS OF INNER MONGOLIA

Six centuries have passed since the great Asiatic empire of Genghis Khan began crumbling. Today, the descendants of his hard-riding tribesmen are more peaceful, but many still insist on remaining a nomadic people. These wandering herdsmen are found mainly in Inner Mongolia and to a lesser extent in Outer Mongolia, farther north. These two politically distinct lands comprise a geographical region usually called Mongolia, which lies between Siberia and China proper.

This homeland of the great Khan's followers, and now of their descendants, has remote mountain ranges and the Gobi Desert. But it also includes the vast uplands of Inner Mongolia where, after harsh winter, the springtime grass may grow three feet high in a month. Here the nomads continue their tradition of raising large flocks of sheep and goats for wool (they also have varying numbers of cattle. camels, and yaks). This requires the Mongols to be constantly on the move with their herds and carts, ever seeking water and greener pastures. Other times, son joins father (as seen on the facing page) for inspection tours of the herds, with both dressed identically from crown of turbaned head to tip of boots—horsemanship starts early in this "wild west" of the Far East.

The horses seem ridiculously small for an adult but serve an important purpose in the grassland culture. These tough little "Mongol ponies" are used to drive livestock when the time comes to seek better grazing, and this includes moving the herds of horses, which are raised for sale as well as riding. The Mongol pony must also provide fast pursuit when his rider wants to cut a replacement out of the herd and tame him to accept saddle and bridle. The chase is not always in a straight line—the fleeing animal is adept at dodging the rider's lasso, which is simply a noose at the end of a long pole (*see photographs, page 48*). But the quarry's evasive tactics are matched by the rider's skill and persistence. He belongs to "a stubborn, clever, strong people used to very independent ways." This tribute to what she calls "Mongol cowboys" is from diary notes kept by the American-born sculptor

Mongol with his lasso pole and pony. Below: rider begins pounding through herd after the horse he wants for a replacemen

r: with their yurt in background, nomads shear a goat. Above: sheep graze on a vast plateau; caravan of carts is in distance.

Above: industry comes to Silinhot. Below: inside Mongol yurt.

Day's work done, riders tie horses to carts and return to yur

Nomad's young wife wears traditional scarf around her hea

Above: a Mongol wrestling match. Below: at Peitze Temp

Barbara Chase Riboud, who accompanied her husband, the noted French photographer Marc Riboud, to seldom-visited plateau sections of Inner Mongolia.

The Ribouds found other ways in which the horse influences a Mongol's mode of living. Fuel for the cookstove in his yurt—a tent made of wood framework covered with thick felt—is a mixture of dried horse dung and sheep droppings. For his traditional liquor, koumiss, the nomad ferments mare's milk. And habitually he prefers life on horseback—whether lassoing horses in his own peculiar fashion, or when, cowboy-like, he simply disdains walking. But after a day's hard riding comes relaxation in various ways—hard drinking, epic poetry, or the wrestling games that require changing his clothes to the traditional special leather jacket and extra-large pants.

Some of the nomads also belong to a mounted militia. For Mongolia, which in its entirety is about four times the size of Texas, is not quite a pastorally peaceful land. It has become a region of tension, sandwiched between two foreign nations with increasingly hostile versions of communism—the Soviet Union and the People's Republic of China. Even before the current rivalry between the two communisms, the mapmakers had to recognize that "Mongolia" referred to two separate governments. Outer Mongolia, with its million people, is the 46-year-old Mongolian People's Republic, a satellite of the Soviet Union (and claimed by China). Inner Mongolia, somewhat smaller but with a population over ten times larger, has been one of China's three autonomous regions for the past twenty years.

The Chinese, an ethnically different people whom Mongols call "sons of Han," have brought other than political changes to Mongolia. Back in the sixteenth century, remembering their experiences with the conquering khans, they deliberately introduced Buddhist Lamaism, to bring into its priesthood those Mongols who might otherwise become troublesome warriors. More recently, the Han influence has taken other directions, with the result that Inner Mongolia is no longer entirely a nomadic land. Chinese have been crossing the Great Wall into Inner Mongolia's less remote sections with their army, agriculture, and industry. The town of Silinhot, for example, is no longer merely a Lamaist temple and a few mud houses. Peitze Temple has lost much of its influence and wealth; most of its monks have turned to secular work. Silinhot is now a city of 20,000 people with a power station and such small industries as a tannery and carpet factory.

Equally significant, "Hanification" and its communes have reduced disease. As a result, the number of Mongols increases. But the number of Chinese increases even faster, so the Mongols have become a minority in their own land—except out in the lonely grasslands.

There the Ribouds found nomad Mongols already under Chinese influence, but nonetheless clinging to tradition. From Mme. Riboud's diary: "There are eleven of us sitting in a Mongolian tent . . . it is round in shape and has a stove in the middle. . . . The tent has a fantastic sense of permanence; thick rugs and a heavy covering on the walls . . . red-lacquered tables. . . . The Mongolians in their quilted robes, turbans, lined wind-burned faces; a twenty-seven-year-old shepherd and his young wife, sloe-eyed and beautiful," who is in her traditional dress and wears a colorful scarf tied around her head.

But these people, she learned, were following a herd of sheep and a herd of cattle. They had been here five days; in ten more days they would move with all their possessions to new grassland. And there the portable yurt would be home—until they moved again.

MELANCHOLY FATE OF *SALMO SALAR*

by ANTHONY NETBOY

We not only overfished the Atlantic salmon and polluted its rivers; we built dams it could not conquer on the long voyage home to breed. Today's remedies: Are they too little, too late?

Early last year, Secretary of the nterior Stewart L. Udall gave Amer- ans a picture of the wildlife re- ources of the nation. "Despite un- recedented conservation in 1965," is year-end report stated, " we are ill losing the over-all battle to save merica's endangered species of fish nd wildlife from extinction." He sted 78 species that are threatened ith annihilation. Among them is *lmo salar*, the Atlantic salmon.

It is hard for Americans who have ever seen these salmon in the river the marketplace, or tasted their cculent flesh, to realize that they ere once as numerous as the Pacific lmon are now in some rivers of regon and Washington, or in Brit- h Columbia and Alaska.

The Atlantic salmon is a member the Salmonidae family of fishes, hich can be traced to a common an- stor in the Pliocene Epoch. Orig- ally, *S. salar* inhabited nearly all e suitable European rivers flowing to the Atlantic and Arctic oceans, om northern Spain to northern orway and as far east as the Kara ver in Soviet Russia. In North nerica they penetrated hundreds of reams from Ungava Bay, in north- n Quebec, down to the Housatonic ver, in New England. A landlocked riety inhabited Lakes Ontario and Champlain and their feeder streams, as well as several smaller lakes in upstate New York and Maine.

The typical Atlantic salmon, upon returning to its natal river after a sojourn of one to three years in the ocean, is a fairly large fish, silvery and roseate, its lithe body tending to turn coppery as it nears the spawning stage. Its average weight in North America is from fifteen to twenty pounds, although larger specimens are caught. Norway probably breeds more large Atlantic salmon than any other country, and these frequently reach fifty to sixty pounds.

Salmon typically go through a precisely regulated and wondrous life cycle. Born in a gravelly stream, the young fish spends its first two to four years in fresh water, usually in headwaters of a rushing river. It feeds on microscopic insect life, is transformed into a tiny parr with red and black spots (in this, salmon closely resemble the trout family), and then acquires the distinctive silvery hue of the smolt before embarking on its oceanic quest for food. At this stage it weighs but a few ounces and may be four to six inches long.

We now know that fishes from both sides of the Atlantic have a rendezvous in western Greenland waters. Here, in the last five years, salmon have been netted on their feeding migrations. Of more than 100 tagged specimens netted, two came from Maine. They had journeyed about 1,900 nautical miles, almost doubling their weight in fourteen months.

Salmon, as is well known, are anadromous fish that will spawn only in their natal waters. They return to "their" river by a navigation method that is unfathomable to man. In the river they ordinarily do not feed—the fat they accumulated in the ocean will sustain them until they spawn. Unlike Pacific salmon, all of whom die after the terrible ordeal of mating, many Atlantic salmon, usually the females, can recuperate and find their way back to the ocean. A spawned-out salmon is known as a kelt. Many kelts return to the river to spawn again—in some rare cases even three or four times. The maximum longevity of the Atlantic salmon is about ten years.

What is left of the vast hordes of Atlantic salmon that inhabited North America before the white man came to its shores? Canada has managed to retain substantial stocks, although much reduced from eighteenth-century levels, but south of the Canadian border *S. salar* is barely hanging on. No nation has frittered away this valuable resource as wantonly as has the United States.

Salmon is the first fish mentioned in the chronicles of North America. About the year 1000, the Icelander Leif Ericson and his followers reported that they settled in a land called Vinland, "where there was no lack of salmon . . . either in the river or in the lake, and larger salmon than . . . ever seen before." Historians still argue where these Vikings landed, but it must have been within the

from the sea, intent on spawning esh waters where they themselves born, salmon leap to overcome nultuous hurdle in "their" river.

range of *S. salar*, anywhere from Cape Cod to the coast of Labrador.

After northeastern North America was rediscovered five centuries later, followed by colonization and growth, the most renowned salmon river below Canada was probably the Connecticut. In this river, the largest in New England, the fish wandered as far as Colebrook, New Hampshire, after scaling many impressive waterfalls. They bred in the Connecticut's headwaters and in various tributaries. They nosed their way past all obstacles for 150 miles along the main stem of the crystalline Merrimack, which rises in the White Mountains, and into the Pemigewasset and even the subtributary Baker's River. Some also frequented the Contoocook.

In what is now Maine, the most famous salmon river was the Penobscot, almost as long as the Connecticut and receiving the flow of numerous affluents. *S. salar* also used to ascend the pellucid Kennebec as far as Carratunk Falls, and some hardy individuals managed to hurdle this 16½-foot obstacle to spawn in the upper tributaries.

Summing up the situation south of the Canadian border, Charles G. Atkins, the leading nineteenth-century American authority on the Atlantic salmon, counted 28 rivers, not including their tributaries, known to have harbored regular runs of the salmon. Landlocked varieties proliferated in Lake Champlain, Lake Ontario, and their feeder streams.

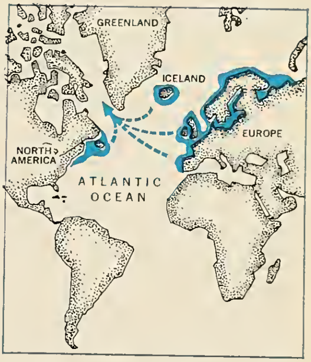
Such abundance had its usefulness. The records show that salmon was an important food for some Indian tribes—more important probably than the wild turkey of Puritan fame. The red man taught the white how to fish for salmon. Commonly, the Indians spearfished at the falls of the rivers where the salmon congregated. Bellows Falls, on the Connecticut, was a favorite camping ground for the Abnaki because of the plentiful salmon, shad, and other migratory fish that came up to this point. At the confluence of the Concord and Merrimack rivers was a fishing station that antedated the white man. And salmon were speared by the hundreds at Amoskeag Falls, where the river roared wildly over granite ridges and, in the course of the next half mile, fell 80 feet, throwing up a ceaseless spray.

By the second half of the eighteenth century the salmon industr was important in the Connecticu Valley and elsewhere. Families alon the rivers would put in a winter' supply of salmon by spearing them i the water or purchasing them fo about a shilling apiece. As the Colonial era came to a close, however, th anadromous fisheries were alread facing dangers. Only a few settlements, such as Machias, Maine, ha the foresight to require bypasses a dams and gaps in the fishing weirs.

In time, many of the early dam fell into disrepair and were aba doned. But they continued to o struct the streams and made fish m gration difficult or impossible. Suc a disaster befell the Connecticut. I 1798 the Upper Locks and Can Company built a 16-foot dam at Mi lers River, a hundred miles from th sea. It had no bypass for fish. Late

The homeward urge is powerful; so is the river. Salmo salar *gathers strength before it enters the swirling waters.*

Competition: Salmon have slowed down ere to jockey for position in their omeward journey up a river in Canada.



The white areas show original range of Atlantic salmon; dashes indicate routes to rendezvous in Greenland waters.

other dams were erected downstream. Already by 1810, few anadromous fishes could be found in the Connecticut. And when a solitary salmon strayed into the river in 1872, Saybrook fishermen, never having seen such a fish, could not identify it.

The major trouble began, however, when industrialists seized upon the waterpower of the New England rivers for their cotton and woolen mills, their woodworking, cutlery, and gun plants. Salmon runs ceased in the Merrimack about 1860. Some years earlier, Henry Thoreau in his leisurely journey down the Concord and Merrimack rivers had already noted that they were losing their fish life: "Salmon, shad and alewives were formerly abundant here, and taken in weirs by the Indians, who taught this method to the whites, by whom they were used as food and manure, until the dam and afterward the canal at Billerica, and the factories at Lowell, put an end to their migration hitherward; though it is thought that a few more enterprising shad may still be seen."

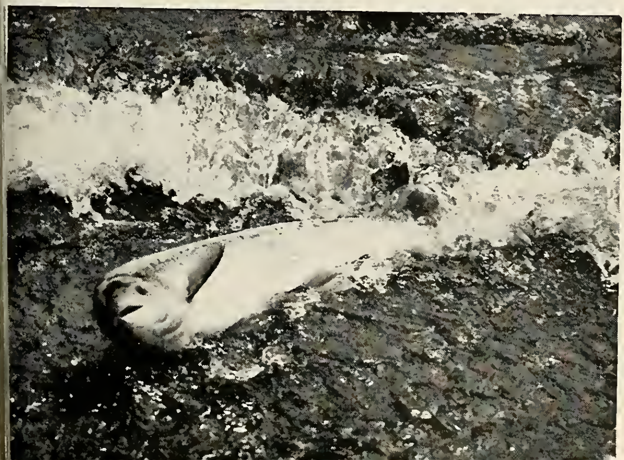
In Maine, the salmon rivers had flowed through dense coniferous forest. But most of this was cut clear in the middle of the nineteenth century. The rivers fell victims to pollution from logging debris and sawdust, to log jams that sometimes stretched for miles, to silt caused in streams by improper logging practices, and to a multitude of dams that impounded water for small manufacturing operations. Later came the pulp mills, which poured their slimy liquors into the rivers, and the twentieth century brought the hydroelectric dams built without fish ladders.

By 1870 only eight of Maine's two score rivers could support regular runs of salmon. The fish were occasionally seen in six others; in the rest they were but a memory. Typical was the fate of the Penobscot. In 1872 it was still yielding 15,000 salmon to net and weir fishermen. In 1947, when salmon weirs were finally declared illegal in Maine—a century too late—the entire commercial catch was only 40 fish.

The same melancholy history was written elsewhere. Rivers flowing into Lake Ontario once possessed tremendous stocks of *S. salar*. The Jesuit Fathers Le Moyne and Le Mercier on their mission to the Onondaga Indians in 1654 were astonished to see their hosts come down the Oswego in canoes filled with fat, silvery salmon. Some fifty rivers and creeks on both sides of the lake thronged with salmon. On the American side they were found not only in the Oswego but also in the Genesee and Salmon rivers and in smaller streams draining into Lake Ontario. The fish spawned in the rivers, left them as smolts to spend their feeding years in the lake, and returned to reproduce in natal waters. So abundant were salmon in the Finger Lakes region early in the nineteenth century that farmers, it is said, hauled them out of the Seneca River by the wagonload. They were also taken at the mouth of the Oswego—before an Oswego-Syracuse canal rendered this river unfit as salmon habitat.

Farther west in New York, visit today's metropolis of Rochester and gaze upon the Genesee River. You can hardly imagine that large numbers of salmon were caught here 150 years ago. Prodigious shoals came up every spring and summer, migrating as far as the falls of the river. But in 1817 industrialist Elisha Clark built a dam at Rochester, and it completely blocked the river. As usual, he had neglected to equip it with a fish ladder. Subsequently, it is reported, over 10,000 salmon were killed in the vicinity of Rochester with clubs, spears, and pitchforks as they strove to reach their spawning grounds.

Eastward, in the region of New York's Adirondacks, the species was found in the St. Regis, Chateaugay, Grass, and Salmon rivers, which flow into the St. Lawrence River. At historic Lake Champlain, which drains north through Canada's Richelieu River and into the St. Lawrence, the cool, pure water of the lake, fringed with forests, was ideal habitat for salmon. Streams that feed into Lake



Grounded: This salmon went off course; to survive, it must thrash its way back to the river's swimmable depth.

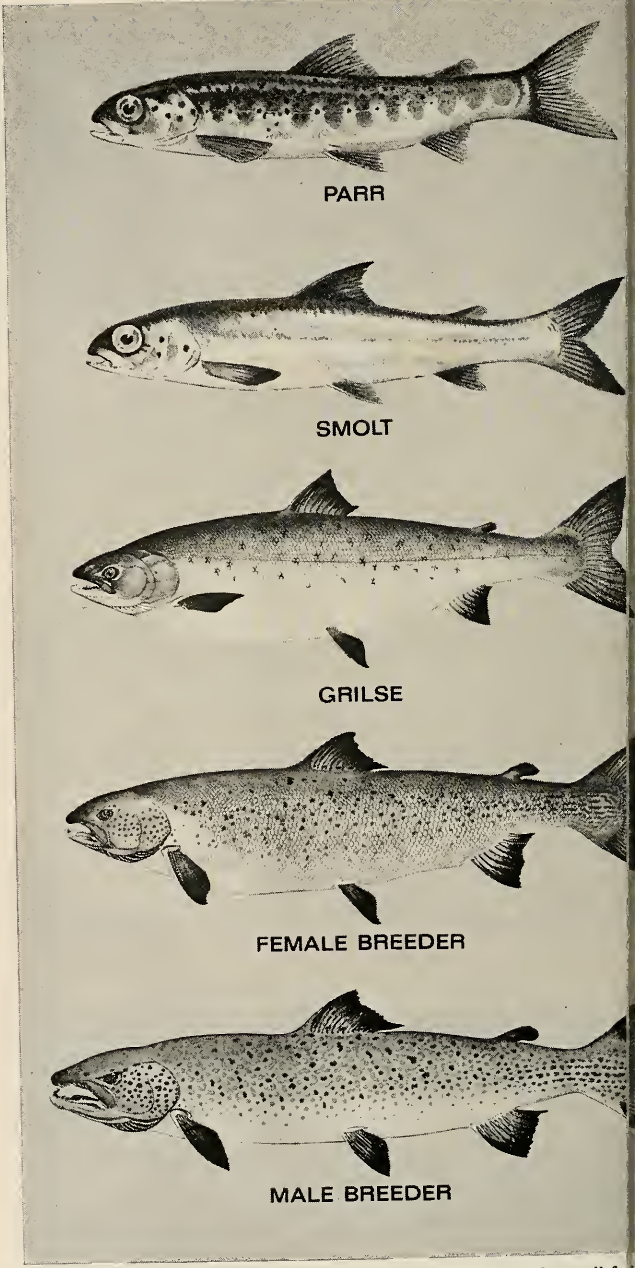
Champlain are: from Vermont, the Missisquoi River, which empties into Missisquoi Bay at Swanton, Otter Creek, and the Winooski River; from New York, the Saranac and the Great and Little Chazy rivers.

Tales of former salmon abundance were still heard in the Champlain Valley a century ago, when they were already nonexistent in that area (and would soon become extinct in Lake Ontario, too). In 1872, for instance, a Plattsburgh hotel owner said his grandfather had seen shoals so thick at the mouth of the Saranac that "their capture by cartload was an easy matter." Others told of salmon-choked creeks that horses could not cross.

What kind of salmon inhabited Lake Champlain—sea-run through the St. Lawrence or landlocked? This question was long debated. Then, about 1940, two Canadian biologists examined a pair of museum specimens and found that these fish had never been to sea; their life history was the same as that of the Lake Ontario salmon. They, too, sometimes reached a size of thirty to forty pounds.

The Lake Ontario and Lake Champlain salmon stocks were destroyed in these ways, according to Winslow G. Watson, in his *History of Essex County:* "The secluded haunts they loved have been invaded; dams have impeded their wonted routes; the filth of occupied streams has disturbed their cleanly habits; and the clangor of steamboats and machinery has excited their fears. Each of these causes is assigned as a circumstance that has deprived the country of an important article of food and a choice luxury."

Another question, whether the Hudson River ever was a salmon stream, has been argued hotly. Henry Hudson is recorded as having seen salmon leaping in the waters around Sandy Hook and later as he sailed past what are now called the Hudson Highlands. But there are no records of an Indian fishery in the river, nor of any Colonial salmon fishing. And Dr. S. L. Mitchill, pioneer New York ichthyologist, declared that the species was not adapted to the Hudson. Nevertheless, between 1873 and



During its life, Salmo salar *undergoes a procession of changes. After the fry stage it becomes a tiny, spotted parr, then grows into a silvery-hued smolt, which goes to sea for food. On its first return to fresh water, the small fis grilse. The two breeder fish 29-inch adults found in Maine's obscot River. Note the distinc hooked lower jaw of the male spec*

1876, the New York Fish Commis-ion planted 150,000 young Califor-ia salmon in the Hudson's head-vaters and nearly 150,000 in Long sland streams. *Field and Stream* for uly 5, 1877, reported that salmon vere found in considerable numbers ff the mouth of the Hudson and ome were seen as far upstream as Iyde Park.

In 1880 a small planting of Atlan-ic salmon fry was made in the Batten ill, which flows from Vermont into he Hudson River near Troy. Some f these were apparently taken on heir return to the river in 1884. hen, between 1882 and 1886, 00,000 Atlantic salmon were re-eased in the Hudson by the U.S. Fish ommission. Many grew to the smolt tage and went to sea, returning two r three years later weighing 10 to 3 pounds. Individuals were cap-ured as far upriver as below Troy am. This planting obviously pro-uced results, but the dams at Troy, Iechanicsville, and Thompson Falls, icking efficient fishways, prevented eir movement into the headwaters. n 1905, small numbers were seen at Iechanicsville, where Dean Sage, a ell-known angler, recorded they ere caught "by hooks ostensibly aited with pieces of pork and ragged along the bottom until the portsmen' at the other end could el them against a fish, when a hard rk sometimes fastened the hook in e luckless creatures."

No subsequent plantings were ade in the Hudson, so far as I can iscover, and no permanent runs ere developed.

Meanwhile, the sea-run species ere faring no better. Maine's rivers ere dying one by one. In the 1880's, lmon runs appeared regularly only the St. Croix, Dennys, East achias, Machias, Penobscot, Sheep-ot, Kennebec, and Androscoggin vers. Between 1873 and 1889 an erage of 150,000 pounds were still rvested commercially in these wa-rs. By 1900 the total catch had llen to 60,000 pounds. After a brief surgence around 1930, mainly be-use of restocking, the runs petered it. Since 1950 the U.S. Fish and ildlife Service has reported the an-ial commercial salmon catch in aine at less than 1,000 pounds.

The same fate has befallen sports fishing. At first, not many Americans had the leisure or the money for this activity. There were also lingering effects of the Puritan's disapproving attitude toward fishing as a sport. As late as the 1860's, the pools of the Aroostook, Union, and Dennys rivers were known to a few fly fishermen; usually, however, the ardent salmon angler had to go to Canada to indulge his hobby. He continued doing so when Maine's salmon rivers began dying. In 1886 Henry P. Wells, author of *The American Salmon Fisherman*, could name only three rivers where salmon fishing was available: the St. Croix, Dennys, and Penobscot. This compared with over a hundred in eastern Canada.

The Penobscot offered the best sport (though limited), and for the next two decades salmon angling in the eastern United States was virtually confined to this river, mainly at Bangor pool. Fishermen also angled on the St. Croix, and took some salmon out of the Caribou pool on the Aroostook, until the Tinker hydroelectric dam blocked the river in 1906.

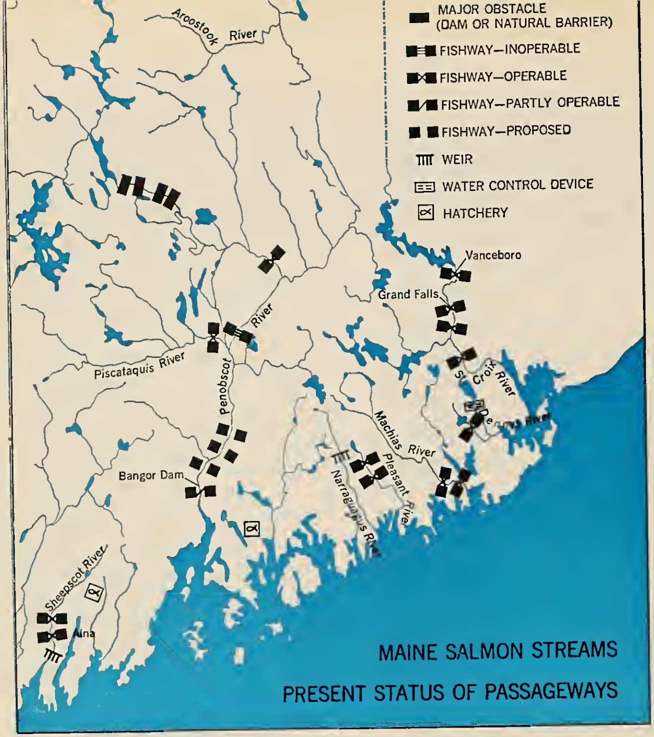
In 1904, when Dean Sage surveyed the chances for salmon fishing, he reported the Penobscot was "going fast," the St. Croix was gradually getting worse, and the Dennys had already faded out. In 1907, Boston newspapers said the sport at Bangor was doomed because of overfishing, pollution by pulp mills, poaching, and insufficient restocking. Moreover, weir fishermen in Penobscot Bay were working night and day, at every tide, without interference. There was, of course, no closed season and apparently no regulation whatever. Few salmon were caught by anglers in Maine after this time, except for the small landlocked species found in some small lakes. By 1940 the Penobscot was virtually a dead river. Its salmon were scarce; fly fishing had ended at Bangor pool.

When rivers become barren it is difficult to bring them back to life. Usually the national interest in them withers and ultimately dies. For instance, there has been little or no attempt to revive the sterile salmon rivers of Portugal, France, Finland, Spain, and Poland. In Spain, in 1942, the government did ban net fishing, turning the meager resource over to the fly fishermen. But these efforts have not improved the runs to any measurable extent.

In the United States little interest was shown in the Atlantic salmon's fate until after World War II. (A glorious opportunity had been missed to rehabilitate some of the rivers during the Depression, when public works money and WPA labor were available.) Efforts to rebuild the Maine salmon runs started with the organization in 1948 of the Atlantic Sea-Run Salmon Commission, with headquarters at Orono, Maine. That state has appropriated about $35,000 annually for the rehabilitation program, and the federal government has joined in with several hundred thousand dollars spent on modernizing the Craig Brook hatchery at Orland, and paying its operating expenses. Also, in 1959, Aroostook County fishermen and the state legislators teamed together to obtain $45,000 of state money for special work on the Aroostook River. And funds have been contributed by power companies and timber corporations for work on rivers they helped to despoil.

Maine's program, ably directed by Dr. W. Harry Everhart, of the salmon commission, has concentrated on restocking some of the most promising streams, removing obstructions, and building fishways. The rivers are littered with abandoned dams; at their mouths are fishing weirs and traps, no longer used, which impede the migration of fish.

The restocking began in 1954 and has accelerated at eight selected rivers: the Aroostook, Narraguagus, Dennys, Sheepscot, Penobscot, Machias, Pleasant, and East Machias. Also, various small projects have been completed to facilitate the passage of fish or improve the flow of streams. For instance, a Denil-type fishway was built at Cooper Mills on the Sheepscot River, thus opening new spawning areas. The Dennys, long plagued by low water during the critical period when the salmon enter the river, has been ensured a stable flow, thanks to a water control dam at Cathance Lake. Also, two fish ladders were opened in 1965 on the St. Croix River, and a third in 1966. These will enable salmon, shad, and



By 1968, if Maine's remedial program is fulfilled, salmon will be able to journey freely up the Penobscot River and into its feeder, the Piscataquis. This map also includes the St. Croix, a segment of the U.S.-Canada boundary.

alewives to migrate upriver to their spawning grounds in the headwaters. Pollution below the fish ladder at Woodland, however, is still a problem. If it can be solved, a magnificent international salmon river will have been reclaimed after a century of neglect. The fishway at Mathias Gorge has been improved, and a water control structure and fishway erected on Pleasant River Lake.

As a result of all this work, small runs of salmon have reappeared in the Dennys, Machias, and Narraguagus rivers; also, to a lesser extent, in the Pleasant, East Machias, and Sheepscot. Fly fishing has been resumed and attracts a small number of anglers. Aggregate catches are rising slowly, and in recent years have totaled 400 to 500 salmon annually—a negligible harvest, of course, when compared with those a century ago.

In 1965 Congress passed the Anadromous Fish Act, designed to enhance the supply of salmon and other anadromous species by making funds available to the states for five years on a matching basis. For the current fiscal year, Maine has been allotted $135,000. Additional help may come from the Land and Water Conservation Act. Dr. Everhart explains such federal funds will be spent mainly for fishways to revive the Penobscot's salmon runs; it is hoped the fish will be enabled to reach headwaters of the Piscataquis and its tributaries. The once flourishing East Branch may reopen as a spawning and nursery area.

But it is hard to say how much good all the belated efforts will do for Maine's salmon. Many fly fishermen already dream of taking salmon out of Bangor pool again. Although the Maine salmon commission issues optimistic statements, there is no hope of restoring any salmon rivers in the other New England states.

The question is often asked: Will the Atlantic salmon ever reach anything like its former abundance? The reply of the U.S. Fish and Wildlife Service is: "Probably not, but wise management may some day make them more than the token resource they are today."

The trouble is that *S. salar* was brought to the verge of extinction before Americans developed a sense of conservation. There were almost no federal or state laws in the nineteenth century to protect the freshwater fisheries. When efforts were begun to restore Maine's rivers in the 1940's, it was already too late for any spectacular accomplishments.

For perspective, how does this compare with the future of our Pacific salmon wealth? In the Pacific Northwest, harnessing of the great salmon rivers for hydroelectricity and other purposes did not begin until the 1930's. By this time federal laws were requiring the installation of facilities to safeguard the passage of salmon and other anadromous fish. But the fabulous Columbia River runs, exploited since the 1870's, had already been overfished.

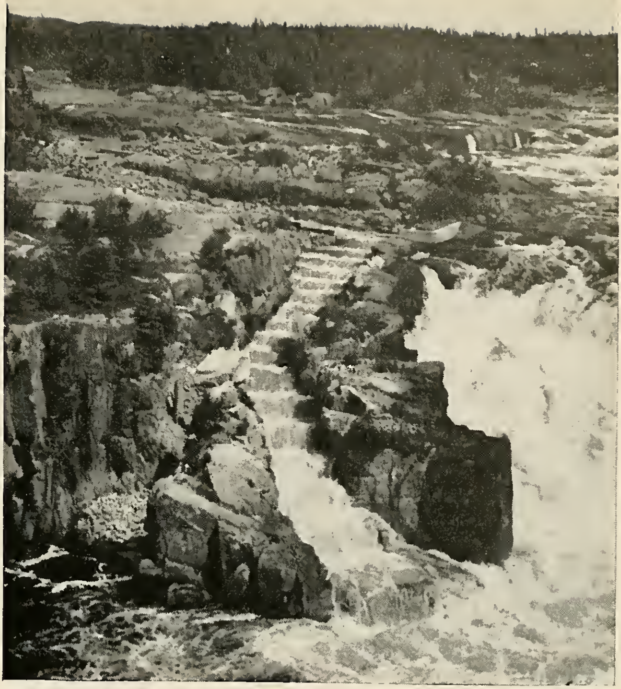
Since 1937, when Bonneville Dam, the first high dam on the Columbia, was completed, the federal government has invested about $150 million in ladders and other fish-passage devices at its dams on the Columbia and Snake rivers, plus about $35 million to build salmon hatcheries. Nor does this take into account the many millions invested by public utility districts and private power companies in fish ladders at the hydroelectric projects they built; also the vast sums supplied for maintaining al these facilities and the huge salmon research programs. In short, no where in the world are such heroic efforts being made to save a fishery

What are the results? The Columbia and Snake river salmon run have been declining at a steady pac in the past two decades, although th runs of coho salmon have revive recently. Grand Coulee Dam alon cut off 1,150 linear miles of spawning grounds—it was built withou fish ladders. And the once extensiv upper Snake River runs are sadl depleted because of defective fish passage devices installed at a privat power dam.

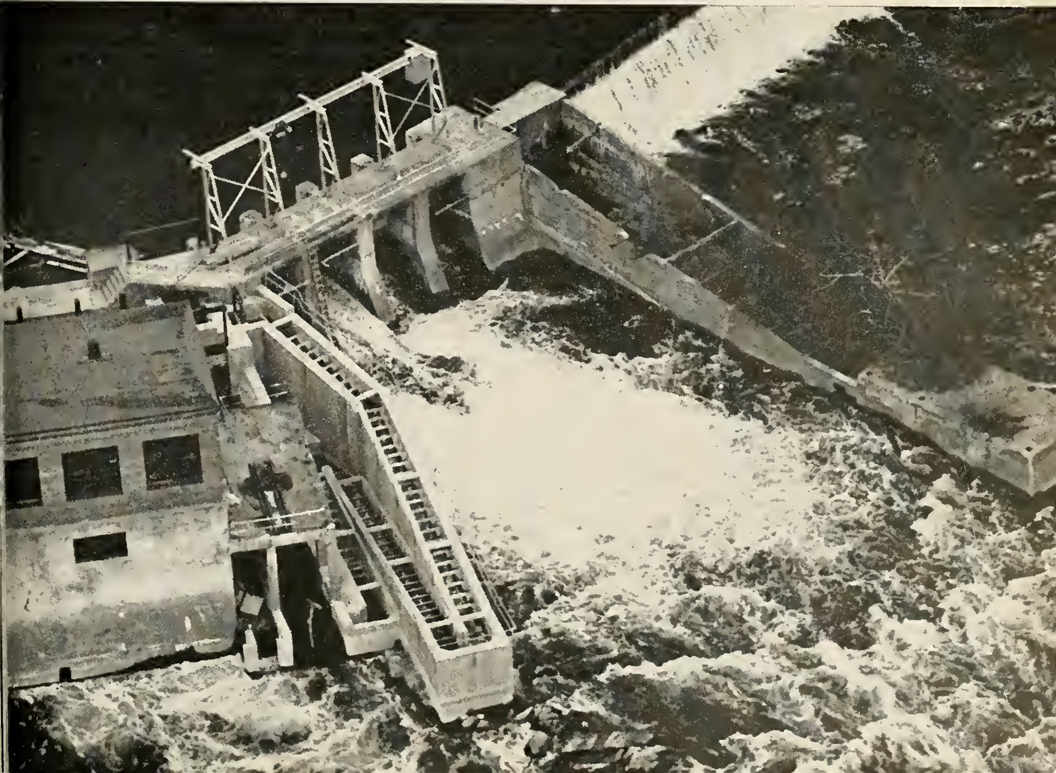
Meanwhile, new dams rise and po lution continues to harm the del cately adjusted salmon in the lowe

Columbia and some of its tributaries; sustaining the over-all runs has required releasing tremendous numbers of hatchery stock. In addition to familiar pollution there are prospects for injuries of the kinds contributed by atomic power plants. There is already the atomic plant at Hanford. A half dozen other such large installations are planned along the Columbia. And as it approaches almost complete development for power purposes it will no longer be a river, but a lake extending from the Canadian border to the end of tidewater. All these radical changes in environment, combined with the need for negotiating so many high dams, may bring further losses to the salmon.

But everything is relative. What happens to the Pacific salmon in the foreseeable future cannot be worse than the present, melancholy plight of *Salmo salar.*



Simple fishway, right, helps homebound salmon to "step-around" a river obstacle. Below, a power dam on the Piscataquis River has both old fishway and newly built, improved version.



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DILEMMA OF THE IROQUOIS

Continued from page 7

man said the cloth given to Onondagas is now only 1½ yards long, coarse and unsuited for clothing. An elderly woman said she remembered when it was 15 yards long. The Onondagas want their annuities updated, and their Indian Agent says this is 'absolutely' impossible. A second major issue is citizenship. Papineau said the Onondaga are a sovereign people: 'The United States can draft us and tell us what to do only because they have the guns and we do not. . . . We do not vote because we are not citizens of the United States—you cannot be a citizen of two governments.' "

There are also "secondary" problems. For example, the Indians cannot get GI bill household loans or FHA-guaranteed loans. They call this discrimination: "We fight your wars and then you do this." To this, government spokesmen reply that the Iroquois ignore the collective ownership of the reservation land by the council, not by individuals. It is only "loaned" to specific Iroquois. The situation is such that a loaning agency could not foreclose, therefore reservation Indians find it very hard to get money for building or improving homes. It is also difficult to get fire insurance, because of inadequate protection against fire.

Attitudes toward the state did not improve after some Onondaga land was condemned for a flood-control dam, with promises that it would form a man-made lake where the Indians could fish, canoe, and swim. The dam was built ten years ago, but the reservation still has floods and the Indians deride the foot or so of water behind the dam.

Relations with the local anti-poverty program are also strained. Manpower Development and Training has had some success, mostly through the efforts of one man, now departed. Project Headstart was doomed right at the beginning when its lecturer told a hall filled with parents that the program was intended for the child from a broken home where the parents did not care about education, could not help the student even if they wanted to, etc.

The Onondagas are particularly bitter about the symbols of state power: the police and the Indian Agent, who oversees the reservation

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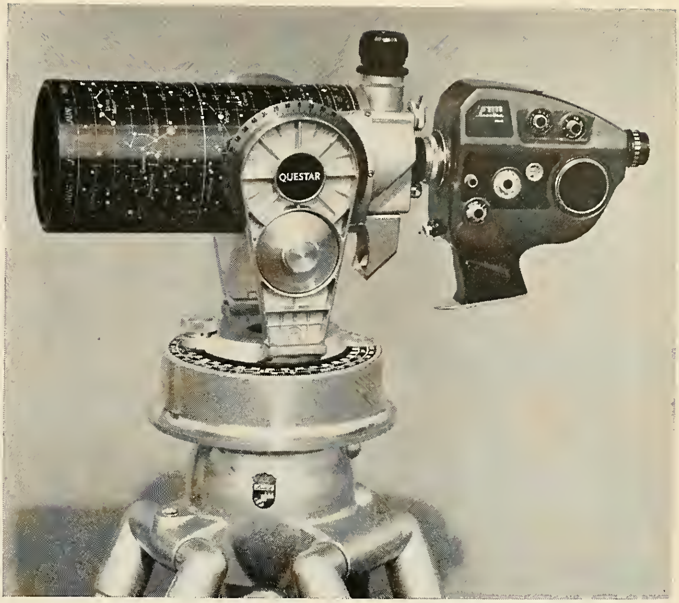
(his home is near the reservation and contains his office; he is also a funeral director). The agent, Clifford Hall, has commented that most problems between the Onondagas and the state result from Indian "imagination." The Onondagas have one complaint, however, that is symbolic as well as real. When visiting Hall they may not use the front door. He says they have muddy feet: "They got to come in the door they're supposed to —the side door."

The agent's superior is the state's Director of Indian Affairs, John Hathorn. He denies that New York has plans to terminate the reservation, although it is possible that with construction of new roads and other public works, the reservation will be chipped away. That, of course, is precisely what the Indians fear. When their Indian Agent discussed termination, he put it another way: "If they behave themselves there won't be any trouble."

The Progressive Senecas

The Seneca reservations at Allegany and Cattaraugus, in the lower western section of the state, are vastly different from other Iroquois reservations. They have been different for many years. In 1838, a land scandal involving a land company and some bogus chiefs resulted in division of the Senecas into four reservations. One is now part of the city of Buffalo; one is at Tonawanda. On he other two, at Cattaraugus and llegany, the scandal led to a revoution ten years later. A majority of on-ranking Senecas deposed their hiefs, separated church and state, ramed a constitution providing for president and legislature, and ransferred jurisdiction over major rimes and serious lawsuits to the tate courts. The new regime applied or, and received, a charter from the ederal government establishing a elf-contained Seneca community emoved from jurisdiction of the eague Council, therefore functionlly and emotionally detached from he confederacy.

Revolutionary change of another ind began over a century later, in 962. Now came Kinzua, which in eneca means "fish on spear." The deral government, acting on an rmy Corps of Engineers plan, ought 10,000 acres of Seneca land r a flood-control area behind the



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We have some experimental reels here that they have taken showing men fishing on a pier about 2,000 feet distant, rice birds catching insects and gulls working busily on the Gulf of Mexico shore, both at about 500 feet, and, at the other extreme, tiny sand crabs, no larger than silver dollars, swarming at 30 feet. All demonstrate Questar's remarkable resolving power even with distant moving objects under difficult lighting conditions. With equal clarity you can discern facial expressions at 2,000 feet and the feather detail of birds in motion. And, of course, the close-up study of small animal or insect life at great enlargement is a fascinating possibility.

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Allegheny River's Kinzua Dam in Pennsylvania. This climaxed a crisis that had been building for decades. William N. Fenton, a leading authority on the Iroquois, notes that "Kinzua . . . has been on Seneca minds since 1928, hanging like a dark cloud above their homes and lands, threatening to inundate the best of the river bottoms and to break up the community which maintains their religious life; it would flood the grave of their grandfathers and obliterate the sacred places where their prophet Handsome Lake arose to preach."

Despite the Indians' charges that their treaty rights were being violated, and the aid from their many sympathizers, the government plan went through. More than one third of the Allegany reservation's 1,800 Seneca citizens had to be relocated. For their land, the Seneca nation received slightly more than $15 million. The response of its Indians has been dramatic. They had fought vigorously to save Seneca territory; having lost, they now turned much creativity and skill to the effective use of the funds. Beautiful community buildings were constructed on both reservations, an educational fund was established to provide assistance to Seneca children, and industrial and recreational facilities are being built or planned. Some help has come from the U. S. Bureau of Indian Affairs and committees of sympathetic citizens. Senecas are grateful. But the main, driving energy is their own collective will. For instance, the Nation's various committees have relocated families to be displaced by the flooding into both public and non-public homes: the 35 new public housing units at Cattaraugus, and 25 at Allegany, are attractive middle-class suburban types.

Allegany's 30,469 acres straddle the Allegheny River from the Pennsylvania border up into New York and back to the border again. Indians on this reservation are not insulated from whites as they are in the state's other reservations. Some small towns, plus almost the entire city of Salamanca, lie within the reservation. Salamanca people rent the land cheaply from the Seneca Nation on 99-year leases, which will expire in 1991. Understandably, the most serious concern at Allegany is termination. A rider on the Kinzua

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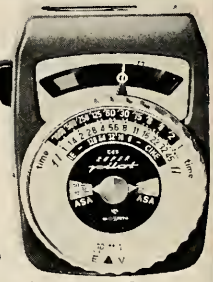

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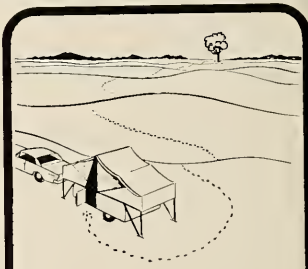

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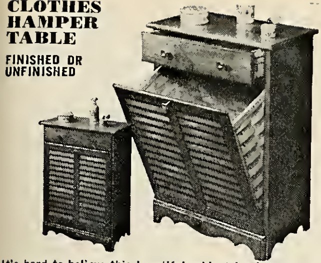

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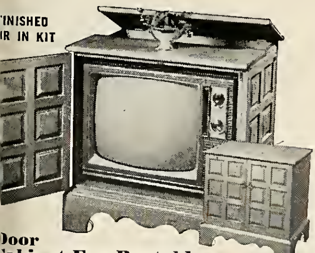

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Bill mandated the establishment of a joint committee of Senecas and some western tribes to meet with the Bureau of Indian Affairs and think ahead to termination. Although the Senecas are relatively progressive, and most see termination as inevitable, but not necessarily desirable, all wish it to be self-termination. Martin Seneca. former president of the Nation, says: "Termination would abolish the Seneca people as a nation because it takes away the land base. Where would the Irish be without Ireland?"

Indian independence is threatened not only by the loss of land but by economic weakness. What almost all Indian communities need most is capital. Accordingly, a committee of Senecas and outside experts has generated a program for converting much of the Allegany reservation into a living Indian museum called "Iroquoia." The plans include a recreational park with athletic fields; sporting areas for canoeing and fishing; and sleeping accommodations for guests—all with a distinctly Iroquois motif. Iroquoia is at present going through a feasibility study funded by the Federal Economic Development Administration.

The plans can be viewed in the community house at Allegany. Like an identical building at Cattaraugus, it was built with money from the Kinzua compensation. A far cry from the ancient longhouse, these are sparkling buildings complete with picture windows and thick rugs. They function as the center of Seneca activity, providing craft rooms, libraries, gymnasiums, a cafeteria, meeting rooms for the legislature, and efficiently modern offices for the growing Seneca bureaucracy—the Nation's housing enterprises, relocation authority, educational foundation, and cemetery commission.

Many of the enterprises housed in each building were triggered by the Kinzua events. Also with the money as a base, the Nation has established scholarships for sending Seneca children (75 this past year) to college as well as to business and vocational schools. In the past, ambitious, well-educated Indians have had to migrate to urban areas. Now, Senecas hope that a new pillow factory at Cattaraugus will provide opportunity not only for the college graduates but also for less educated members

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of their community. The factory is expected ultimately to provide 150 jobs for the Nation. Again using Kinzua funds, the Indians shared costs with the pillow manufacturer. FEDA helped by bringing electrical power to the six-acre site. Concerning this willingness to work with the government, Martin Seneca noted that reservation Indians elsewhere have been reluctant to co-operate with the state and federal governments, but relations between the Seneca and the state are "grade A." He went on: "Others do not take advantage of the state programs, of voting and so on. They feel that noninvolvement will bring security. Maybe it is just the other way around."

The Cattaraugus reservation, approximately forty miles north of Allegany, is home for 2,200 Senecas. It has some lovely houses, but poverty is evident, too. Portions of the reservation are tranquil and beautiful. In other areas, particularly the western section, where the pillow factory is located, one finds the New York State Thruway, other major roads, and numerous everyday businesses similar to those in the town of Salamanca. This region is very active, but except for the souvenir shops, not very Indian. Non-Indians at Cattaraugus rent land from the Seneca Nation just as they do at Allegany, and do considerable co-op farming. (The Indians no longer work the land, but at one time they had impressive farms.)

Last summer, Martin Seneca ruminated on prospects and saw growing improvement. Over 50 per cent of eligible Senecas vote; in a recent election the Nation's vote was decisive in choosing the representative to the state legislature. A community action committee is being formed to generate ideas and projects for development. Mr. Seneca explained: "The need now is for highly skilled personnel, such as doctors, lawyers and accountants who are Senecas and will handle the affairs of the Nation. Until now, there was nothing to attract educated people back to the reservations."

Of course, he noted, if Congress wants to terminate the reservations it has the power—the army. In the end it comes to that. The Onondaga, too, seriously point out that the state can assert its will only because of its army. All Iroquois recognize the

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nature of the power relationships—but they have developed different strategies. For the Seneca, it is reluc-ant accommodation; for the Onon-daga, it is resistance. But despite the difference in strategy, they share basic desires. The Indians want to get what they can and keep what they have—a few special privileges, par-icularly tax-free land. And like any other group they want aid without control, benefits without costs, and service without paying more than hey have already paid. But unlike others, they feel theirs is a historical and moral right to all they ask.

The Future

New York State's Indian popula-ion is growing, and except for a few hundred on Long Island, all are roquois. In 1930 there were only ,500 Iroquois; today there are 5,000 (10,000 of whom live on res-rvations). The state, of course, pro-ides them with many services—ducation for their children, health linics, welfare when needed, unem-loyment compensation, police pro-ection, and so forth. In this respect hey are treated more or less like ther citizens. Moreover, they notice lessening discrimination, largely as result of positive fallout from the ivil rights movement. On the other and, high school students attending ie same schools as Onondaga chil-ren report anti-Indian feelings mong the white students. This in-icates some overlap between the ruggle by Negroes and Indians for ieir rights. Both groups share com-ion concerns: the need for demo-atic pluralism, challenges of cul-ural diversity, charges of police arassment, racial discrimination, nd economic problems. But a politi-l link with the civil rights move-ent is improbable. Iroquois are nti-Negro—they are not overtly emonstrative, do not like people ho are, and were never slaves. They gard themselves as a class distinct om, and better than, Negroes.

A common denominator at all Iro-ois reservations is, of course, the ead of termination. Some whites gue that without termination the dians will languish on the reserva-ns and more dependency will be ed. But if projects like the pillow ctory succeed, the reservations ay experience an economic regen-ation. Moreover, in a democracy

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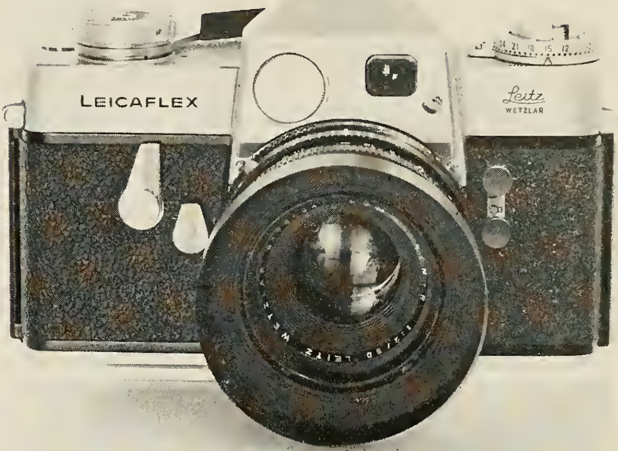

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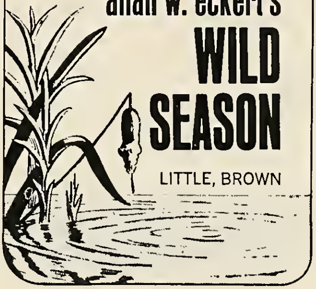

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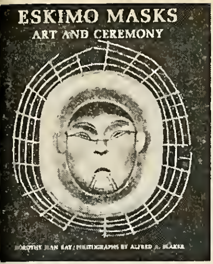
important decisions should be made by the people themselves. It is significant that some non-Indians agree this should apply to the Iroquois. For instance, at the height of their battle with the State Power Authority over some land, the Tuscarora Indians received significant and serious support from people living in nearby towns.

Also, a reservation Indian feels that if he is doing well, he is in a friendly, comfortable environment and the land is tax-free; and if unemployed, it is more pleasant to be at Onondaga than on New York City's Bowery. Finally, reservations have a spiritual meaning for the Indians. Edmund Wilson's superb *Apologies to the Iroquois* quotes an Indian as saying, "The land is my mother. You cannot sell your mother."

What about the argument by some whites that the real answer to Indian problems is education? This traditional American faith in education i in part justifiable; it was magnificently successful for many people especially the waves of immigrants But it is equally clear that faith in education, per se, is being shaken b experiences in our major cities today. What we are learning is that a individual cannot "bootstrap" without boots. For education to succee the learner must see a payoff for hi efforts. It will take more than education in a vacuum to stir the mos passive reservations.

This returns us to the contrast between Seneca and Onondaga. Th Seneca have a serious measure c control over their own lives and ca chart their future with some hop For the Onondaga the situation different. Their relations with th state are so poisoned by past exper ence that their attitude is one of mi trust and despair.

But in the end, for complete different reasons, the Seneca and th Onondaga face the same dilemm how to survive as a nation. The Se eca feel that with successive gener tions their better-educated offspri may tend to leave the reservation a vanish into the larger society. T Seneca's problem is how to avo dissolving themselves. The Onc daga, on the other hand, are dor nated by a feeling of utter powerle ness. Their problem is how to avo being dissolved by outsiders.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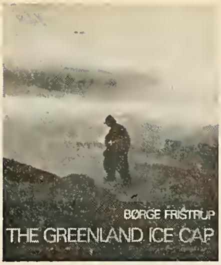
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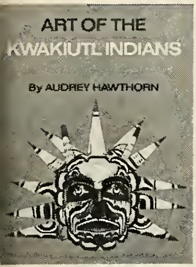
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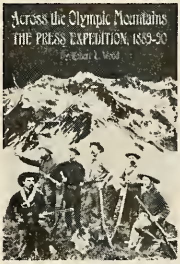
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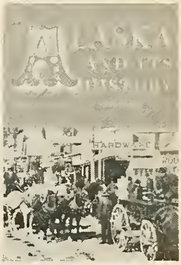

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By Harry L. Shapiro

Understanding Evolution, by Herbert H. Ross. *Prentice-Hall, Inc., $4.95; 175 pp., illus. Paperback, $2.45.* Human Evolution, by Bernard Campbell. *Aldine Publishing Co., $8.95; 425 pp., illus.*

In the century that has elapsed since Darwin there has been no diminution in either the interest or the research in evolution. Each generation has produced its classics in the field, and in recent times the activity has become so intense that the flow of general books on the subject has increased noticeably, particularly in certain segments of the evolutionary spectrum. This is especially evident in human evolution where fossil discoveries pertinent to man have been more abundant in the recent past than in any other comparable period of time. But much of this increased production, both in investigation and in the necessary summarizing and stocktaking reports, has been stimulated not only by the new insights provided primarily by genetics but also by recent research in a number of other biological fields.

Much of the earlier literature was necessarily concerned with amassing data that reinforced the general concept of evolution and that demonstrated the widest possible validity of its principles. Those were the days when evolution was fighting its way to acceptance and when incontrovertible evidence of the reality of this creative force was perhaps more critical than analyses of the detailed steps by which it achieved variation and change. Anyway, in retrospect it is hard to see that much could have been accomplished in decoding the mechanism—the how of evolution—until essential advances had been achieved by genetics, a subject scarcely known even in its most primitive form in Darwin's day. The gene as the ultimate source of biological characteristics and the seat of organic change, or mutation, was recognized soon after 1900 when the genetic principles of Mendel were rediscovered, but not until population genetics emerged as a special development did the full impact of this n
discipline modify profoundly the ba
preoccupation of students of evoluti
For population genetics took as one
its principal tasks the analysis
microevolution by studying the gene
dynamics of populations. And since
cutting edge of evolution is at t
level, the insights provided by this n
approach have both enriched evo
tionary concepts and focused attent
on its functioning mechanisms.

The two books under review refl
these changes of orientation and m
else, besides. One, *Understanding E
lution*, by Herbert H. Ross, takes e
lution in its fullest sense for its the
The other, *Human Evolution*, by B
nard Campbell, is limited to one sm
segment of evolution—man's. But b
are rich in the detail appropriate to
level from which they view their
spective subjects.

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own solar system. It describes the
ture and origin of life and consid
the various ideas and experiments
throw light on the special condit
that made life possible at all—certa
an extraordinary event. The di
entiations, adaptations, and incr
ing complexities that constitute ev
tion are rehearsed succinctly
broadly and with excellent coverag
the limited space available. The p
ess that achieved 1,500,000 known
ing species of organic life, not co
ing those that became extinct or t
that are still not identified in the
maining terra incognita of the org
world, is startling witness of the
traordinary adaptability of life. M
but not all, of the remainder of
book is devoted to the mechanism
which this amazing diversity cam
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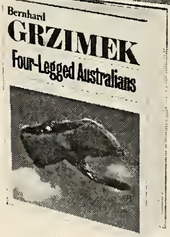

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calities wherever possible, but even when some are inevitable, his exposition of them is always clear and penetrable. His book makes a solid, reliable introductory guide to this fascinating and far from static subject.

Human Evolution is quite a different kind of book. Its scope is perhaps closer to the average reader's interest, for Dr. Campbell concentrates almost entirely on the human family and its primate relatives and antecedents. Moreover, unlike most books on the subject that have appeared in the past, he gives only incidental attention to the discovery of the fossil record and to descriptions of the fossil remains themselves. Thus he avoids what must be rather tedious to the unconditioned reader—the long, detailed discussions of resemblances and putative relationships between the increasing number of hominid fossils. The state of the art has reached the point where the broad trend of human evolution is sufficiently well marked, even if the minutiae be in debate, to allow him to stress other aspects of the story—physical, physiological, neurological, and behavioral—that not only mark the change from one primate ancestor to our own condition but that also made this evolution take the direction it did.

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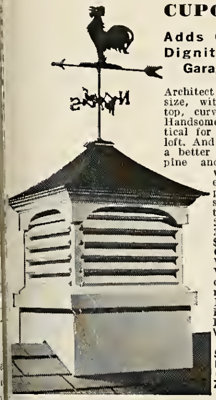

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Calling upon the recent work in neurology and the studies of primate behavior in the field, he has brought into the picture the enormously significant effects of behavior, particularly organized, or social, behavior. The acquisition of language and the capacity it gave man for complex types of group behavior are shown to have played a major role in the more recent phases of the story.

The discussion of the role of behavior and the emergence of culture also brings forward an aspect that has been receiving more and more attention in the last decade or so. This is the increasing influence—feedback if you like—of culture on man's own evolution. As man adapts to a changing and increasingly complex culture, he is in effect modifying the very environment that, in turn, exerts pressure upon him. He can be said to be unwittingly guiding his own evolution!

Human Evolution makes good reading, but it has its exasperations as well. It is good because the author has summarized admirably the current literature not available to the general reader and has done so in an exceptionally straightforward way that should present no obstacles. But I suppose it must be a powerful temptation in writing a book of this kind to try to dot all the *i*'s and cross all the *t*'s, and when the evidence is lacking or inadequate, to offer likely suppositions that will contribute to a neat continuity and a satisfying symmetry of cause and effect. Dr. Ross in *Understanding Evolution* falls occasionally into this practice, but generally he makes it clear enough that a bit of guesswork is being offered. The whole field of evolution with its distressing lacunae is perhaps especially susceptible to this rather disturbing habit. Dr. Campbell, however, is freer in his assumptions. Again and again he makes easy deductions for which there is no proof. And even when these are labeled as "probable" or "likely," they end up a few paragraphs later as facts. Thus, although *Human Evolution* makes good reading and in its main theses is generally reliable, the cautious reader should have a saltceller handy for some of the speculations.

Dr. Harry L. Shapiro is Chairman of the Department of Anthropology at The American Museum of Natural History.

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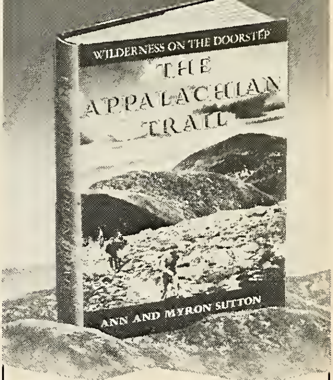

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possessions. Added to this, the increasing availability of leisure time has promoted the participation of tens of thousands of people in the lapidary, or gem cutting and polishing, hobby. This being the case, there certainly is a demand for a well-written, authoritative book on the science of gems, a book that could introduce the reader to the record of gems through the ages—a record as old as history itself. Such a book should cover in considerable detail the nature, formation, occurrence, and, perhaps, the recovery of these precious items, bearing in mind their essential relationship to the more prosaic materials in the world. In addition, it should enhance the reader's awareness of the natural phenomena that are responsible for the particular character of the different gems.

The cutting and polishing of stones is certainly dependent on their physical properties and as such should be described, and perhaps a section on the preparation of the finished product—the manufacture of jewelry—is not entirely inappropriate. Finally, such a book would be immensely more useful to both the gemologist and lapidarist if it included comprehensive tables of gem properties.

This might have been the prescription used for the book here reviewed. Unfortunately the finished product, although not unpleasant to read, is superficial, and the contents do a disservice to the science of gemology. The title "Jewels," under which this book has been published elsewhere, is more appropriate to the contents, which might be considered suitable as a layman's introduction to this subject.

D. VINCENT MANSON
The American Museum

THE WORLD OF THE MOON, by Henry C. King. *Thomas Y. Crowell Co., $3.95; 125 pp., illus.*

CAN anyone be found who knows nothing about the moon? In the midst of a great space race to place a man on this, our one natural satellite, the newspapers are filled with lunar details both old and new. The science textbooks are increasingly calling young students' attention to the moon and beyond. Surely, all who are inclined to know what secrets the moon may hold have already acquired a respectable background of theories and facts about the lunar world.

According to the introduction, *The World of the Moon* is intended for those who somehow had never thought of the moon but now want a general survey of current knowledge. Fortunately, only the first few pages are suited to this purpose. The author falls easily into a style and level more suited to his space-age audience. He reviews

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th liveliness various reactions to the
on throughout history and then set-
s down to the business of describing
ar phenomena: orbital motion of
moon about the earth; eclipses; the
es; the origin of the moon; selenog-
phy, or the identification and map-
g of surface features; the physical
ture of the lunar surface material;
d finally, the nature of the artificial
ellite programs aimed at the moon.
In many ways, this little volume re-
nbles chapters on the moon found in
od college astronomy textbooks. Dr.
ng covers thoroughly the current
te of our knowledge and, with re-
shing candor, presents various sides
those issues where the experts can-
t yet agree. The text is often heavy
th facts, but nonetheless, flows quite
sily. Unfortunately, the lunar maps
ovided are quite poor and do not
ow all the features mentioned in the
t, and some of those shown are in-
rrect. Serious readers will want a
ch better map at hand. Also, Ameri-
n readers might be annoyed with
many examples aimed at British
aders (solar eclipse paths for this
ntury are shown for Europe only).
The World of the Moon should be
lpful to those who want to know, in
ar though non-technical terms,
out our celestial neighbor.

James F. Wanner
Earlham College

OTE:
In the section on comets in the
ackyard Astronomer" for March,
67, it was erroneously stated that the
rvard College Observatory was still
astronomical clearinghouse, as it
d been for many years. Since 1965,
wever, the official center for report-
discoveries has been at the Smith-
nian Astrophysical Observatory in
mbridge, Massachusetts.
Astronomers should communicate
y discoveries of new comets to the
ntral Bureau for Astronomical Tele-
ams at Smithsonian, using the high-
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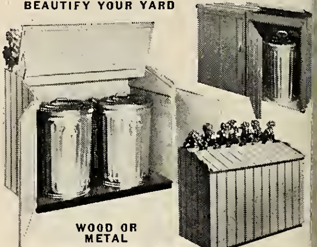

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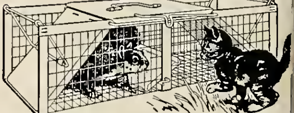

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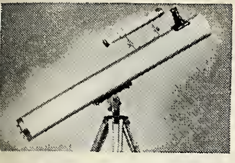

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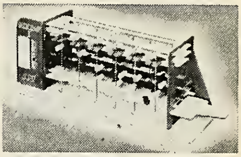

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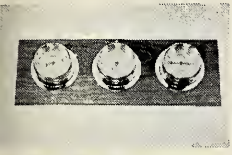

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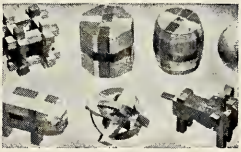

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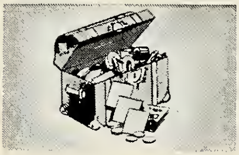

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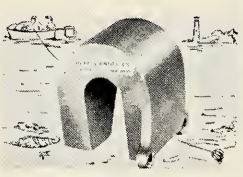

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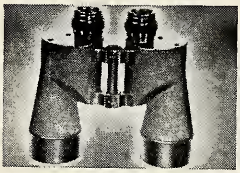

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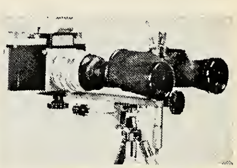

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Letters to the Editor

La Vida

As a former resident of Puerto Rico (though not a Puerto Rican) and a person fluent in Spanish including idiomatic use of the language, and as a student of anthropology over many years—I take exception to several of the comments Señor Monserrat makes ["Reviews." April, NATURAL HISTORY].

For one thing—not to go into great detail—I do not agree that to the general reader or even to the Spanish-alert reader, the title *La Vida* necessarily suggests the prostitute. A common expression among all Latins when confronted by some sort of distress, is "Aie, la vida"—meaning nothing more nor less than "Oh, that's life for you!"

I do not see the great contradictions pointed out by the reviewer, that is, as he sees them; they are qualifying rather than contradictory elements in the study, as far as I have been able to ascertain through perusal of many reviews and parts of the study itself.

I have been sent other reviews from Puerto Rico—wherein a sort of nationalism rather than a detachment suitable to the reviewing of a serious study—has taken over. In other words—and in a way quite inevitably—the review takes the book as a personal affront to . . . Puerto Rican culture as a whole—rather than as a study of one part and a subsection of that part.

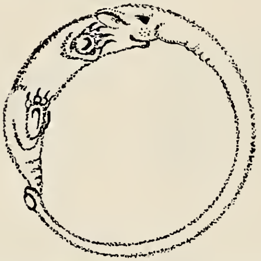
This is an anomaly—personal and indignant reviewing of a scientific study. I think the magazine should at least give the writer of the book a chance to answer the statements of a very (nationalistically) prejudiced reviewer.

MRS. MAURICE KAMEN-KAYE
Tulsa, Oklahoma

The Snouters

I have to thank you for the publication of Dr. Stümpke's most interesting observations on the Rhinogradentia (in the April issue of Natural History). I believe you have resolved a mystery that has long been a subject of controversy in my family.

Among the souvenirs of service in the South Pacific sent home by a relative who must even now be nameless (he was an intelligence agent who has since vanished in the course of his professional duties) was a hoop of soft yellow metal carefully wrought into the likeness of a grotesque beast. Where my kinsman obtained this artifact, which might have been a small bracelet or rather large earring, he would never say. Members of the family have expressed the most diverse opinions of its provenience and have professed to see in it the more or less distorted likeness of a veritable menagerie of creatures. Now, however, we are all agreed that the animal represented is a hitherto unrecognized species of Rhinogradentian, and that the article so long in question must have been the handiwork of an Hooakha-Hutchi smith in Hi-yi-yi.



This agreement, however, raises more questions than it resolves. If the sculpture is in fact an accurate representation of an actual animal, can it be that the form of the piece was dictated not by the desire to employ it as a personal ornament but because such is, or was, the posture in which the creature was commonly seen? If so, for what reason would any animal assume such an attitude? Surely, to roll downhill! We have no clue to the predator from which escape was so imperative, but the form of the feet of the "Hoop Snouter" powerfully suggests the nature of the slopes up which it must subsequently scramble. They are not only clawed, each is soled with what appears to be a large suction cup such as would give purchase on a smooth wet surface. The glacial ice and polished granite peaks of Hy-dud-dye-fee must have afforded just such a habitat. Moreover, the attenuated nasarium of the Hoop Snouter would seem to be well adapted to plucking Glacier Roaches from their crevices in the ice. (Alas that we can not dispatch an expedition to Hy-dud-dye-fee to investigate the possibilities suggested by the structure of this curious creature!)

Realizing at last the rarity and interest of this small sculpture, we were resolved to donate it to The American Museum. Resolution came too late. A young cousin, who had received a casting set for his birthday, had melted it down, together with some lead soldiers and a silver spoon, and cast the metal into the mold of an imaginary Martian. (Incidentally, this brings to mind another point of interest. If a model as competent as this one was made in Hi-yi-yi, the natives cannot have been quite the "Children of Nature" that Petersson-Skämtkvist supposed.) Lest all record of the Hoop Snouter be lost, I have made a sketch of it from memory which I hope you will forward to whom so ever it should most properly be of interest.

ALICE GRAY
Department of Entomology
The American Museum

On behalf of the National Organization for Snouter Ecology (NOSE), I wish to thank you for bringing to light the brilliant and little known work of Harald Stümpke.

ROBERT P. BAKER
President, NOSE
Newark, New Jersey

You're putting me on—aren't you?

S. DE RUGGIERO
Lt., SC, USN
Oxon Hill, Maryland

[Yes. The snouters, alas, are creatures of the imagination. Ed.]

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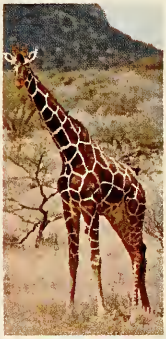
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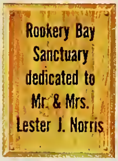
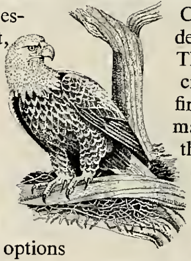


There were Mr. and Mrs. Lester J. Norris, who got things going by working out options on the land. There was Charles J. Draper, who pulled the effort together into a businesslike organization. George Vega, an attorney, got his neighbors to sign a 50-foot long petition to the County Commission.

A biologist named Joel Kuperberg enlisted willing help from state and private scientists. Nelson J. Sanford, a prodigious fund raiser, outdid himself for the cause.



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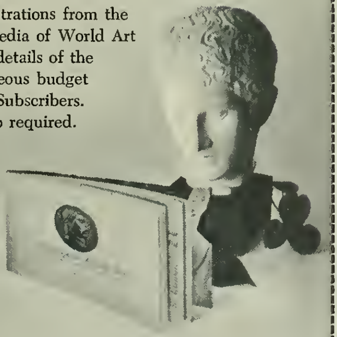

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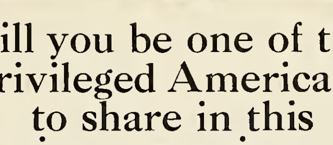

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THE PARK 8

This fictionalized account by a NATURAL HISTORY *editor focuses on some of the factors that shape the form and function of a metropolitan park system, and determine the place of nature in an urban setting.*

FROM THE LOG OF THE "TE VEGA" 24

Rolf L. Bolin

Originally a millionaire's yacht, the Te Vega *has served in a number of ocean-going roles. She is now a scientific vessel. Rolf Bolin, former Chief Scientist of Te Vega Expeditions, logs a typical voyage for the reader.*

THE ADAPTIVE IBIS 32

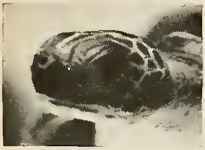
Helen Hays

The Glossy Ibis, long known to nest only in the vicinity of Florida's Okeechobee swamp, has recently acquired a number of new nesting sites along the East Coast.

MUSEO NACIONAL DE ANTROPOLOGIA DE MEXICO 34

Shirley Gorenstein *Photographs by Lee Boltin*

Mexico's new museum of anthropology has been described by Dr. Gorenstein as a masterpiece of stylistic harmony, an artistic combination of Middle American artifacts (see Olmec sculpture in cover photo) and architectural beauty.



100 TURTLE EGGS 46

Archie Carr

Are the one hundred eggs laid by a female sea turtle more or fewer than are needed to insure the survival of the species? His many years of observing these animals has shown Archie Carr that this number is just about right.

SABLE ISLAND 54

Fred Bruemmer

Sable Island is an unusual place. In a photographic essay, Fred Bruemmer presents a picture of the more outstanding features of this mist-enshrouded island.

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THE AUTHORS

Rolf L. Bolin

Shirley Gorenstein

Helen Hays

Archie Carr

Fred Bruemmer

ROLF L. BOLIN, author of "From the Log of the 'Te Vega,' " notes that a voyage aboard this ship places the ocean-bound scientist in "intimate relation to the sea." Similarly, a reading of his article imparts a feeling of being aboard this yacht turned scientific vessel, rolling in the Pacific, watching intently for various types of marine life.

Dr. Bolin, Professor of Biology at Stanford University and former Chief Scientist of the Te Vega Expeditions, has participated in many such excursions. In addition to his current trip aboard the *Te Vega*, a "graduate school at sea" operating from Hopkins Marine Station in California, the author's research has taken him from Europe to the Solomon Islands, and from Central America to the South China Sea, searching the globe and its oceans for biological data.

Author of "Museo Nacional de Antropología de México," SHIRLEY GORENSTEIN is a Lecturer in Anthropology at Columbia University. Her research interests in pre-Hispanic military and political organization brought her to Mexico and gave her the opportunity to observe the unique Mexican museum during the course of her summer research. In conjunction with her teaching position, Dr. Gorenstein currently conducts archeological field work in the vicinity of New York City. In 1965, she wrote *Introduction to Archeology*, a book now used by some eastern colleges and universities as a class text.

The photographs for Dr. Gorenstein's article were taken by LEE BOLTIN, a frequent contributor to NATURAL HISTORY. Mr. Boltin, whose pictures have appeared in many books and magazines, has had considerable experience in photographing Latin American art objects and archeological artifacts. He is the recipient of many awards for photographic ability, including the Edinburgh Film Festival prize for his documentary, *Way of the Navajo.*

Since graduation from Wellesl
College, HELEN HAYS has turned h
attention to ornithology. She has co
ducted a considerable amount of fie
research and has assisted such not
ornithologists as Dr. Robert Cus
man Murphy. In the New York are
Miss Hays has worked on sever
waterfowl surveys and has produc
a film on the Ruddy Duck at the J
maica Bay Wildlife Refuge. Curren
ly she is engaged in a study of ter
on Long Island Sound, in addition
her work as a research assistant
Cornell University's Medical Scho

Much of what is now known of t
great green sea turtle is a result of t
work of ARCHIE CARR. Since 195
Dr. Carr has devoted considerab
time to investigating the many my
teries that surround the life of th
gentle sea animal, and he has becon
an outstanding authority on t
species.

In addition to being a Profess
of Zoology at the University of Flo
ida in Gainesville, Dr. Carr is a R
search Associate of The Americ
Museum of Natural History. He h
published a number of books and a
ticles that combine careful, scienti
observation with an unusual sensiti
ity for the workings of natural pro
esses. "100 Turtle Eggs" is such
article. It is taken from Dr. Car
newest book, *So Excellent a Fishe,*
be published this fall by the Natur
History Press.

FRED BRUEMMER, a native of La
via, worked as a photographer an
journalist for Canadian newspape
before turning to free-lance photo
raphy and journalism. Since 195
Mr. Bruemmer has pursued his c
reer as a writer-photographer in E
rope, North Africa, and Canada.

This month, this author's pho
graphic essay tells the strange sto
of Sable Island, a crescent-shap
strip of sand off the coast of No
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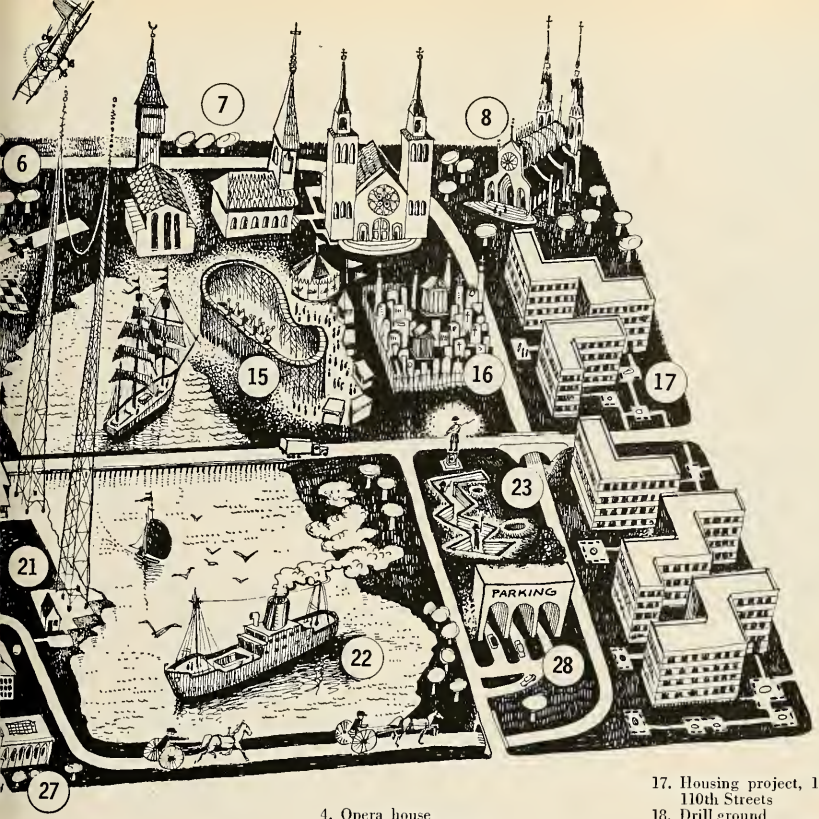
THE PARK

A tale set in New York's Central Park focuses on the very real problems of a city park system and the place of nature in an urban environment

The morning of May 17, 1967, was freshly cool and truly springlike, an uncommon state of affairs in the city of New York, where the transition between winter and summer is sometimes abrupt enough to melt the Van Cortlandt Park snow before skiers reach the bottom of their slope. Forty or so persons had gathered on this Wednesday for a nature walk in Central Park, to be conducted by the curator and historian of the park, Henry H. Reed. Later they would listen to the first major public address of the newly appointed Parks Commissioner, August H. Heckscher. The slow parting of winter had not only tested the biological clocks of the returning robins. it had also prolonged the annual burst of spring energy, and the park was still bathed in the delicate greenness typical of mid-April. an appropriate setting for the announcement of any policy changes that the new Commissioner might apply to the 37,000 acres of the city park system.

In spring, it is easy to linger too long at the edge of a pond or lake, watching the mist rise and roll, and on this morning, one young man found himself separated from Mr. Reed's group. He wandered across a dewy meadow, onto a bridle path that skirted the reservoir and led a different part of the 840-acre p The landscape, originally laid more than 100 years ago by a g team of park designers, Frede Law Olmsted and Calvert Vaux, did an effective job of screening the surrounding city, and he dered if these men had foreseen day when their first park woul main the only sizable patch of g ery poking through one of the la slabs of concrete in the world.

Although Central Park is the frequented park in the world f size, most of its 12 million an visitors come on weekday aftern



artial list of "improvements" suggested New York's Central Park since its in- tion in 1858. Due to the abundance of posals and the limitations of space, our st was unable to show all improvements their planned locations on the map ve.

School for Industrial Arts and Music Center
Exposition Building
Police garage

4. Opera house
5. Airplane landing field
6. Racetrack around park
7. Churches for all sects
8. People's Cathedral
9. Circus grounds
10. Statue of Buddha
11. Roadway to relieve (1923) traffic congestion
12. Carillon tower
13. Recreation center for the elderly
14. Sports stadium
15. Amusement park
16. Graveyard
17. Housing project, 106th to 110th Streets
18. Drill ground
19. El station as monument to elevated railroad
20. Marionette theater
21. Radio broadcasting station
22. Steamboat and sailing ship
23. Trenches in North Meadow as war display
24. Huntington Hartford café
25. Garden for the blind
26. Building lots proposed by Mayor LaGuardia
27. Metropolitan Museum of Art
28. Underground 30,000-car garage

l on weekends. Early in the morn- , there are few picnickers, ball- yers, concertgoers, or kitefliers to seen. And while automobile traffic always heavy during daylight urs, the sunken transverse roads l off much of the noise and lend to relative solitude of the prenoon osphere.

Entering The Ramble, a walk ough one of the park's most vily wooded sections, he unex- tedly came upon a gray-bearded n with a pair of field glasses, gaz- into a tangle of branches at the of a dead oak tree, where a barn rested—a rare visitor to the metropolitan park. The presence of the brown bird seemed to excite the naturalist, for he did not avert his gaze as the young man approached. But after several minutes of watching the chin-on-chest head-swiveling of the owl, the nature lover turned silently to the intruder and handed him the glasses.

Adjusting the binoculars to his eyes, the young man entertained himself for a few minutes by reading a marvelous variety of human thoughts into the expression of the bird. But his period of anthropomorphic investigation was disturbed by the sensation that he himself was being scrutinized by the bird watcher. Quickly he lowered the glasses. His suspicion was confirmed, for the bearded man was intently studying his face, in an apparent search for some kind of understanding. "Thank you," the young man said as he nervously handed the binoculars back to their owner.

For long moments, the bird watcher did not answer. Then, cautiously, he gestured with one hand toward the expanse of rocky ledges, stately elms, and gray-green sycamores that surrounded them and said, "They want to turn this into a racetrack, you know."

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Slightly taken aback by what he realized was an attempt to affect his political point of view, the young man nevertheless decided to ask who "they" were.

"It doesn't matter *who* they are," the man said. "It may be a private group or a branch of the city government, perhaps a philanthropic millionaire, the Parks Commissioner himself, or anyone who wants to leave a lasting monument to his name in the form of a 'project.' " He said this last word with great disdain, as if he had had frequent and unpleasant encounters with enemies called "projects."

"Do you mean that all those people want to build a racetrack? Why haven't I read about it in the newspapers?" Thinking back a few months to a news item he had seen, he said, "I remember a battle over a proposed police stable in Central Park, some angry words between the former Commissioner and his critics who said that he wanted to add an indoor polo field to the stable complex. But that was some time ago. Is this racetrack a new idea?"

"No, it's not new," the naturalist replied, somewhat indignantly. "Almost every idea has been thought of before, you know. And no matter if it's a racetrack or a polo field, whether it was proposed yesterday or in 1900, or whether it's scheduled for Central Park or Hyde Park in London. The important thing to keep in mind is that this is an unending process that occurs wherever you have people and land. These overtures are continually being made, amazingly enough, by relatively well-intentioned individuals; that's what makes them hard to resist! Here," he said, pulling a long sheet of paper from the pocket of his tweed jacket, "look at this list of projects proposed for this park in the last hundred years."

The sheet contained the dates and names of a multitude of "suggested park improvements": an airplane landing strip, a graveyard, a railway, a 30,000-car parking lot, a stadium, a racetrack, public cafés, building lots, an art museum, a marionette theater, an old-age recreation hall, a school for industrial arts and music, a radio station, a people's cathedral, permanent circus tents, a statue of Buddha, and numerous others. Some of these were laughable. Some, he knew, had indeed been installed in the park. And some seemed– though defunct—eminently wort Finished reading, he looked inq ingly at the bird watcher.

"I know what you're thinkin the older man said. "You won how I can oppose such institutions old age, religion, Christian bur and 'progress.' The answer is don't. But there are usually m suitable alternatives to putting th things in park space. Unfortunate parks often represent the path least resistance for all sorts of c cial projects, from police stables highways, from cafés to garb dumps. The land is free and unoc pied by buildings; there are no tax no encumbrances, or problems relocation—very tempting. It's ev more tempting when a rich phil thropist donates the money for pet project . . . in advance. But a li must be drawn, and the way to dr it, of course, is to exclude all p posals that are not parklike."

"That sounds too simple. Just wh is your notion of 'parklike,' for ample?"

"I can tell you how the design of this park viewed it," the man sa putting his field glasses into th case. "They looked at a park as sanctuary from the city. They rec nized, even then, that urban m needed some chance to withdr from his normal, harried envir ment, to see some open country a nature. They knew that many N Yorkers without transportati couldn't retreat to the country.

"For such people, the parks *we* their country. And this is even tru in 1967 than it was one hundr years ago when the city's populati was less than 15 per cent of what it today. That's why a park should be permitted to become an extensi of the city, in the form of buildin highways, and other pieces of t urban establishment. Yet, that's wh is happening. Look at this."

The man pulled a map of Cent Park from another of his ma pockets and showed it as they walk On the bottom it read:

Some Park Acreages	1900	196
buildings, parking, etc.	5	3
paved walks and drives	39	10
open meadow	55	1

"Now remember that list of p posals," he said. "How long will th list have become by 2067 or 216 And even if a very small fraction those projects are accepted, just

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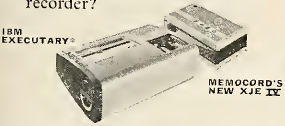

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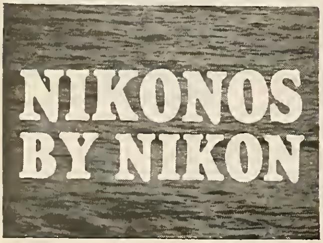

A combination of natural beauty and surrounding cityscape seen from within the p

small fraction, what will that do to the amount of acreage in woods and open spaces? You see, only people and projects grow in number; the size of the land stays the same."

He paused a moment, looking up into the sky where a gull dipped gracefully. "Of course, if man stays around forever, that list will grow infinitely long." He stood, thinking, watching a woman pushing a carriage on the path ahead. Then he said slowly, "Man is an increasingly urban animal. In this city, we have proven that we can live relatively sanely even under very compact circumstances. But we still have open spaces and some reasonably unspoiled natural places to go to; at least we have the awareness that there are such places, if we need them. Tomorrow . . . well," he said with a quick smile, "maybe the truly civilized society of the future will be the one that does not insist on civilizing everything by covering it with a layer of cement."

They walked into an open field in which there were several baseball diamonds surrounded with wire fences. "Even this," the bird watcher said, "is an example of a special u
It denies other users access to
area. General open areas are b
ter, without formally laid-out fiel
without rusting fences, without
scarred diamond after the game
through. Open meadows *can* acco
modate baseball—informal basel
—but they can also be used by oth
for kiteflying or walking or picni
ing. No one gets chased off."

The baseball diamond was, tru
one of the least attractive parts of
park landscape, but the young m
had heard the "democracy in
parks" argument before and knew
to be filled with controversy. He sa
"But there are so many special us
tennis, riding, golf. . . ."

"And to refuse to cater to th
would deny some people their r
reation entirely," the bearded m
agreed. "You're right, this is an a
of compromise. So, we have to th
of all the alternatives. Tennis cou
can be built on the site of a dem
ished building rather than in p
meadows; golf players can use
vate facilities; horseback riders
well, that's a hard one, but they d
occupy fifteen acres of this pa

ex H-16 cine system

some time now Bolex has been making
selling (at ¼ to ⅓ less than any one
the best professional 16mm cine sys-
ou can buy.

IE MAN OPERATION.—Bolex H-16
ras have become famous for their rug-
ess, dependability, quality optics and
weight, making them perfect for one
(Fig. 1) filming operations and elimi-
g the need for any kind of back-up

FIG. 1

M CAPACITY.—The only thing that
H-16 cameras could be faulted on
hat they only had a 100 ft. film ca-

FT. MAGAZINE.—That's why we in-
ced the Bolex 400 ft. film magazine to
th the H-16 REX-5 and the H-16
in the Bolex H-16 cine system.

NCHRONIZATION.—Used with the
onstant speed motor (24 FPS) with
utput for lip-sync on ¼ inch tape and
atic built in clap-stick for easy syn-
ization, the 400 ft. magazine with
the H-16 REX-5 or the H-16 M-5,
the professional user in any branch of
production, science, industry or edu-
unlimited versatility and scope.

E TWO BASIC CAMERAS.—The
REX-5 is a three lens turret camera
offers reflex viewing and focusing on
d glass, allowing the photographer
ete control of composition, framing
rrect evaluation of depth of field. The
M-5, built with economy in mind, is a
lens camera with viewing through a
able optical finder mounted on the
f the camera. The H-16 M-5 takes all
ard "C" mount lenses or Pan Cinor
ngenieux zoom lenses, both equipped
reflex viewing and focusing.

NSES AND ACCESSORIES.—There
fixed focal length lenses from 10mm
mm in the H-16 system, and 7 zoom
giving a wide range of zooming ra-
om 5 to 1 up to 10 to 1, including the
Switar 86EE, the world's first and
fully automatic 16mm variable focal
lens, with zoom from 18 to 86mm.
accessories are available in the H-16
n including motors, close-up attach-
, grips, matte box, titler, light meter,
ng cases and both optical sound and
1/magnetic sound projectors.

MANY APPLICATIONS.—Because of its ruggedness, compactness and light weight a single operator can use the Bolex H-16 system for any of the following applications:

Sports filming, including coaching and training films, for club and school use.
Medical photography, surgical and research filming, Cinephotomicrography.
Advertising, promotion and TV work for both studio and location shooting.
Travel and educational filming.
Wild life and nature photography.
Amateur film making.
Industrial filming, including training, recording, research and work study films.
Memomotion and traffic flow studies.
Periodic industrial data recording.
Underwater filming, (with housing).
Time lapse studies.
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All types of sound work.

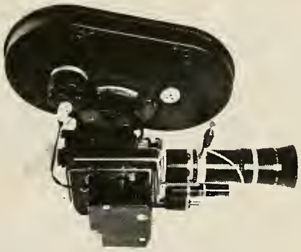

FIG. 2

The H-16 REX-5 camera (Fig. 2), with 400 ft. magazine, 24 FPS constant speed motor, detachable take-up motor on magazine eliminating the use of old fashioned take-up belts. The H-16 REX-5 offers reflex viewing and focusing on ground glass. Variable shutter. Filter slot. Accurate automatic dual frame counters and registrator claw for picture steadiness.

Shown on the camera is a Vario Switar 86EE zoom lens with automatic exposure control and a zoom range of 18 to 86mm. Maximum aperture f/2.5.

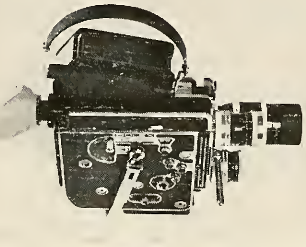

FIG. 3

The H-16 REX-5 (Fig. 3) shown without 400 ft. magazine. The camera takes 100 ft. film loads and has all of the traditional Bolex features such as filter slot, variable shutter for fades, dissolves and greater exposure control, automatic loading and provision to accept the 400 ft. magazine if desired. Lenses shown are Switar 10mm f/1.6, 25mm f/1.4, 75mm f/1.9.

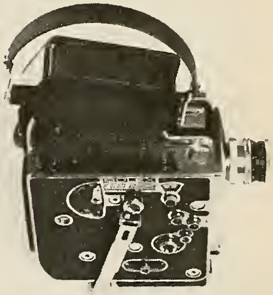

FIG. 4

The Bolex H-16 M-5 (Fig. 4), with single lens mount, an extremely economical, professional quality 16mm camera equipped with such features as variable speeds, single frame shooting, footage and frame counter, unlimited film rewind and automatic threading.

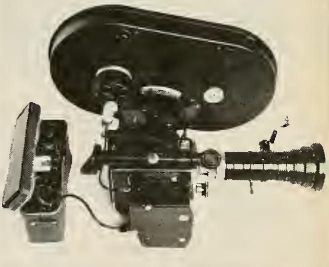

FIG. 5

The H-16 M-5 (Fig. 5) can also be used in conjunction with the 400 ft. magazine, 24 FPS constant speed motor and rechargeable battery pack. This is an ideal set-up for sports filming where a large film capacity is desirable to avoid loss of action footage.

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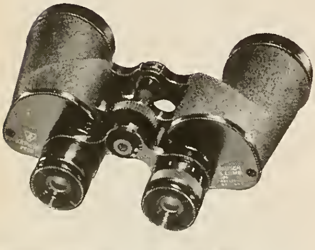

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A misty morning in New York City, looking southward over The Lake in Central Pa

which *can* be walked on and which do not ruin the landscape. It's the extremes we must guard against."

This sounded logical but was certainly not a complete answer. The younger man decided to pursue the matter. "And what about you naturalists and bird watchers?" he asked. "You, for instance, have a wildlife refuge within the city limits —Jamaica Bay—that can only be used for a few bird watchers. In terms of people per acre, how democratic is that?"

"Yes, it's too bad that more people don't appreciate what can be seen in the larger parks," the naturalist said. "Of course, they can't appreciate nature if they have no knowledge of it. You can't value the chance to observe the links in an ecologic chain until you have some idea of what ecology means. Now that I think of it, an education program might be a worthy undertaking for the Parks Department. On the other hand, I don't suppose that the Department can educate the public unless they themselves understand and appreciate what the parks have to offer. Nor can they be expected to grasp the biological importance of some of the dangers to which park lands are exposed. By the way, did you know that the Parks Department has no biologists on its staff?"

"No, I didn't."

Thoughtfully, the naturalist continued, "Perhaps that's why, until recently, the Department never seemed to worry about the pollution of park shores with garbage fill, about destroying irreplaceable natural features in order to build golf courses and highways. Perhaps that's it."

He turned to the young man. "You see," he said. "anything that can man-made is in relatively abund supply, even a golf course built landfill that may take twenty years settle before the topsoil can be put place. But we have yet to learn h to build natural features. Once th are gone, they're gone forever. Th are no known ways to replace th save the operation of natural forc and that takes a long time—four five thousand years in the case o salt marsh; millions of years fo rocky coastline. Naturally, wh these habitats are destroyed, the companying flora and fauna peri with them."

"But," he added, "New York C is still fortunate enough to have s eral large parks in which the natu landscape remains more or less tact. These are being used by stu groups ranging from grade school the college level, ideal outdoor l oratories representing a wide ran of biological situations. Howev the craving eye with which pa lands across the country are view for the purpose of 'sanitary landfi that is, garbage disposal, makes wonder whether we will be reme bered for our foresightedness preserving the irreplaceable or our efficiency in getting rid of cans and coffee grounds."

The bird watcher halted his wa and his speech, long enough to pe through his half-frame spectacles a gray squirrel poised on the side a locust tree. Then he went on, sm ing. "Then there are those who val natural environment apart from scientific and esthetic attribut apart from its ecologic lessons a its irreplaceable status. Some f that man, who was shaped by m

Today's Market

IS GENERAL MOTORS *CHEAP?*
IS AMERICAN TELEPHONE GOOD?
IS GENERAL ELECTRIC *SAFE?*
IS AMERICAN AIRLINES *SPECULATIVE?*
IS XEROX *DEAR?*
IS UNION CARBIDE A *GROWTH* STOCK?

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Q. Has Value Line a crystal ball that can foretell the future?

A. No. But Value Line has made an intelligent and painstaking effort to discern the future in the only way that it can be done, namely through determination of probability.

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lions of years of natural processes—but who sometimes feels that *he* can now do all the necessary shaping—can be properly humbled by taking an occasional look at the natural world. You will even find people whose values are so strange as to suggest that the creatures in the parks have some right to live, just as we do, by virtue of the mere fact that they have been doing it for millions of years."

As they walked toward the Conservatory Gardens, where the new Parks Commissioner was to give his address, the naturalist looked at his listener to see if his final words had had any impact. "Perhaps all that I have said is that there are many criteria by which park use and park users can be judged," he added.

The two of them crossed The Mount in the north end of the park. Looking down the east side of the slope, they could see Commissioner Heckscher addressing an audience in the curve of the Conservatory Gardens. They were late.

"That's a difficult job," the bird watcher said, shaking his head. "And Mr. Heckscher may have a particularly rough time of it."

"How so?"

"He appreciates nature too much."

"That's a disadvantage?"

The bearded man thought for a moment and said, "That depends upon whom you are trying to deal with. The naturalists will love him, but I'm not so sure that the political career of the Parks Commissioner is enhanced by being a nature lover. It's not dramatic enough. There's nothing in keeping the parks clean, in chasing poachers, or in conducting an ecologic survey that will make a splash in the headlines. 'Projects' make the headlines, a floating squash court, an eight-story swimming pool in Central Park, or a tree-trunk painting contest, things that are only superficially related to the real needs and purposes of the park system.

"In fact, I sense a curious change in the official conception of the Parks Commissioner's function. This year, for instance, the Commissioner has acquired the additional title of Recreation and Cultural Affairs Administrator. Now, recreation and cultural activities are certainly legitimate concerns of a metropolis, but I harbor some fear that the attentic
they command will detract from tl
energies that the Commissioner
able to devote to basic park consi
erations. Furthermore, today's er
phasis on culture, in particular, h
endowed that concept with some
the mystical virtues that we normal
reserve for motherhood, God, ar
country. This being the case, I doı
think it unrealistic to forecast a co
ceptual shift in the relative impc
tance of the Commissioner's vario
duties—a shift away from the co
cepts of nature and the natural scie
ces, toward the man-centered notio
of culture and the social science

"I suppose that I could build som
what of a case for these beliefs l
noting that the city budget this ye
contains a proposal for a multim
lion dollar stable complex in Centr
Park, but can spare only $30,000 f
horticultural expenses in the enti
borough of Manhattan. At any rat
it is an interesting trend that encou
ages building in the parks but pr
vides pitifully inadequate funds f
the purpose of maintaining pa
landscape. No, a Commissioner wl
really attempts to do his job ma
find his wings clipped in more tha
one way."

They walked down the hill, arour
some beer cans in the path, and in
the gardens. The Commissioner w
enlarging upon a Gertrude Ste
quotation, in order to describe tl
shrinking stronghold of nature in a
urban world. "There is no *out ther*
out there any more . . . except insof
as we deliberately keep areas of n
ture safe from man's use and depr
dations. . . . If structures and pav
ment take over the world entirel
if green places and growing thin
have no guarded life, then man w
go through the years deprived ar
lopsided. He will be poor, whatev
the gadgetry of affluence arour
him."

It was a good speech, the your
man thought—aware, enthusiasti
and in tune—and he hoped the tu
would be listened to by the city a
ministration. He turned to voice h
concurrence to his bird-watchir
friend, but the bearded man w
gone. He glanced about the hedg
bordered gardens—nowhere in sigl
The naturalist had disappeared in
the landscape. You know, in tl
height of the noonday sun, he ha
vanished like a wispy spirit of tl
park. *Jack Ho*

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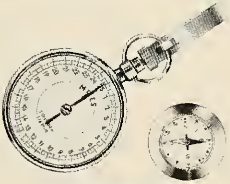

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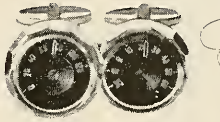

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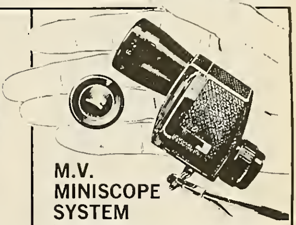

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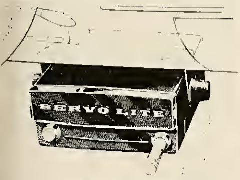

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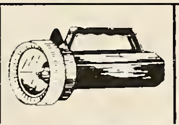

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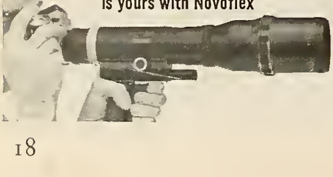
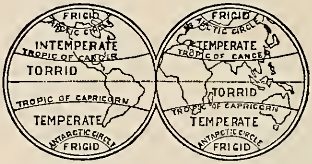


Marston Bates



A Naturalist at Larg

Sometimes I have thought that I missed my profession—that I should have been a filing clerk. At least I love to make catalogues and work out systems of classification. On the other hand, maybe it is just as well that I don't have that professional status, since my systems never seem to work very well—which, of course, doesn't keep me from trying. For years now I have been attempting, off and on, to find ways of analyzing the human ecosystem. There is the problem of trying to classify the different habitats, from cemented cities to maintained nature reserves. And then there is the problem of working out a scheme of categories for the different kinds of relationships that have come to exist between the human animal and other organisms. There are complications, but one category is fairly clear—food. Eating and being eaten.

Our prehuman ancestors, the protohominids, must have been integral parts of the biological communities in which they lived. The structure of the biological community depends on who eats whom—the transference of energy from the producing green plants, through the "key industry animals" that live directly off the plants and the various predators and parasites that eat these, and so to the decomposers who return the materials of the corpses to dust. There are many lines of evidence to indicate that the protohominids were social carnivores, living in hunting packs able to cope with ever larger and more diverse kinds of game as they acquired tools and skills.

The role of the protohominids in the community would thus be comparable to that of wolf packs, differing considerably from that of the li ing primates that we know. who a mostly vegetarian or insectivorous general scroungers of whatever the can collect and digest. I suspect tl protohominids were scroungers to supplementing their meat diet wi nuts, berries, tubers, grubs, eggs, ar the like. They probably also did n scorn jackal-like scavenging: tl aversion to "spoiled" meat is a cu tural trait not shared, for instance, b the British upper classes, who lik their game "high."

Man, or preman, was thus prol ably more miscellaneous in his foo habits than most predators, but h primary impact on fellow anima was surely as a carnivore. I like th statistics collected by Raymond Da (published in *Adventures with th Missing Link*, Harper, 1959) durin his study of 7.159 animal fragmen found associated with australopith cine fossils in a cave at Makapansga in South Africa. He determined tha these represented the remains of a least 39 large bucks of kudu an roan antelope size; 126 medium sized, wildebeeste-type antelopes 100 small, gazelle-like animals; an 28 specimens of a tiny, duiker-lik species. In addition, there were r mains of 4 horses of extinct specie 6 chalicotheres (an extinct type c tree-browsing creature), 6 giraffe (also of extinct species), 5 rhinos, hippopotamus, 20 wart hogs, and 4 baboons. Bones of porcupines, hare and water turtles were found alon

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Marston Bates is a well-known autho who also teaches biology at the Un versity of Michigan. His column no appears regularly in Natural Histor

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Here's what the Hasselblad System consists of. Firstly, the 500C, the standard camera in the system[A]. It accepts all seven lenses available for the Hasselblad, and is a single lens reflex viewing camera. The 500C always shows you exactly how your final picture will turn out on the ground glass screen, in the same way a view camera does. This allows you to concentrate on the setting up and composition of your picture, no matter what lens or accessories you are using on the camera.

The lens, magazine, focusing hood and winding knob of the 500C are all instantly interchangeable.

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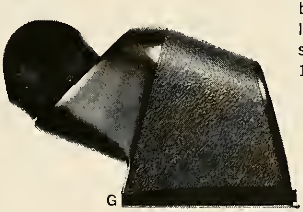

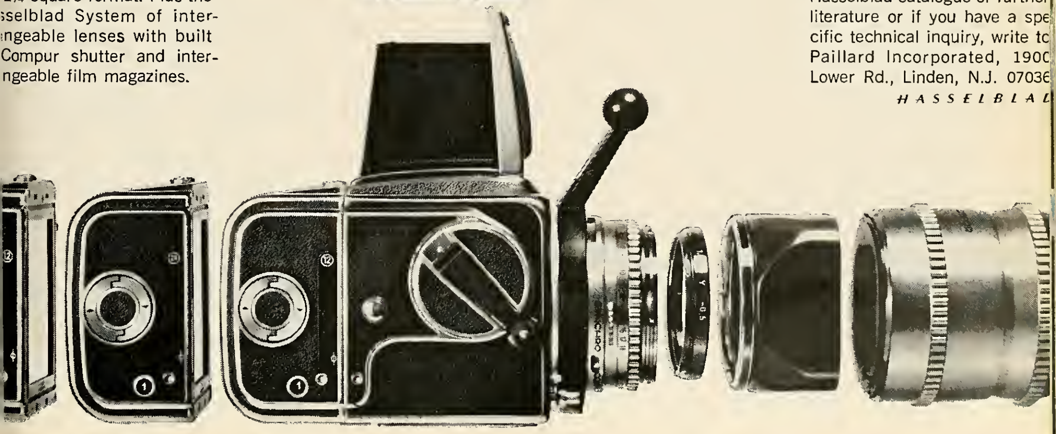

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with this larger game. Fragments of eggshells show that the australopithecines were addicted to bird's-nesting, and crabshells show that they did not mind eating invertebrates.

So much for the food of the protohominids. How about their being eaten? It is difficult to get an idea of the food habits of early man, but it is far more difficult to estimate his role as food for other animals. Hermann Dembeck, in a fascinating book on *Animals and Men* (Natural History Press, 1965), cites the opinion of both L. S. B. Leakey and Herodotus to the effect that man was probably not an attractive prey for the big cats—whether of living or extinct species. "Perhaps the reason the race of man survived," Dembeck says, "is due to his repulsive smell and the bad taste of his flesh."

That is not a very flattering thought. Maybe the occasional lions and leopards that take to man-eating are simply lacking in discrimination. Some species of crocodiles, at least, take to people whenever they get the chance. While on this subject, it has been suggested that the rarity of attacks on man by the big South American anacondas, perfectly able to swallow a calf, may be due to his upright stance which makes him seem to the snake too big to be managed.

I have always heard that cannibals consider fellow men to be a particularly tasty kind of meat. Cannibalism is also generally presumed to be an ancient human habit, in part because the long bones of the fossils of Peking man were split open, and splitting could only be carried out by a fellow man with a tool; other animals would gnaw the bones. Yet Lewis Mumford, in his thought-provoking new book *The Myth of the Machine* (Harcourt, Brace & World, 1967), uses this as an example of the scholarly habit of jumping to conclusions. He points out that "we have no evidence to indicate whether these creatures were killed or died a natural death. If we suppose they were killed, we do not know if homicide was the custom of the country, or whether this was a particular case .... Nor yet do we know if they were killed by their own kind, by another group, or by some more gigantic predatory hominid of a vanished race whose huge teeth were also found in China."

But whatever its history, there is no question that cannibalism has oc-

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curred within widely different cultures in historic times, although tribes have probably often enough been accused of cannibalism on the simple theory that "cannibal" and "savage" were roughly equivalent terms. Anthropologists have had a fine time here with classification: there are exocannibals, who eat only enemies; endocannibals, who eat only friends; various sorts of ritual cannibalism; and the like. But this is just another aspect of the fact that man has been his own chief enemy for quite a while.

Man may not, then, have been a common source of food for any other predator except possibly fellow men. He has long provided food, however, for many other kinds of creatures—the organisms we call parasites. He supports a special kind of flea and three species of lice, and contributes to the food supply of a variety of ticks, mosquitoes, and other biting insects, as well as a considerable fauna and flora of worms, protozoans, bacteria, viruses, and fungi. The parasitic way of life, in the textbooks, is often described as "degenerate." This has always puzzled me. I

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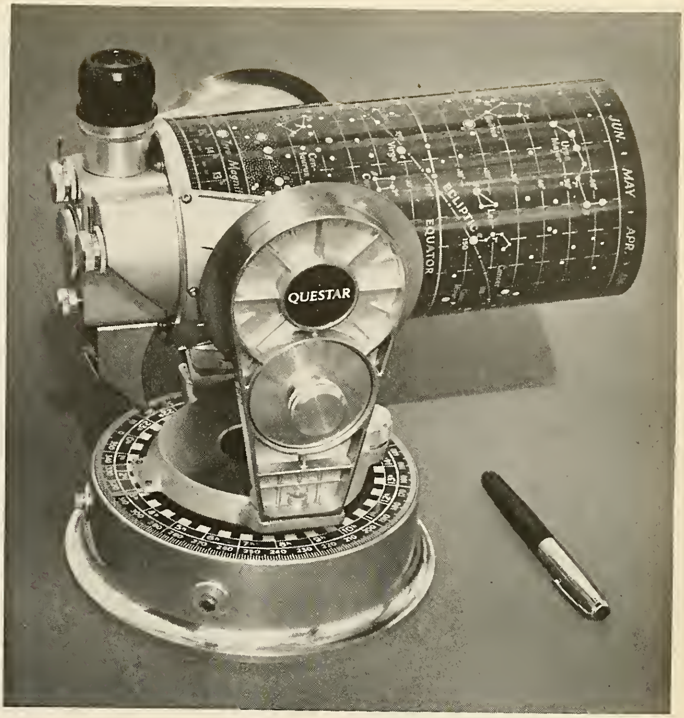

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The descriptive quotation above is the title of a paper published by Patrick H. Verdone of Goddard Space Flight Center, regarding a special all-quartz Questar used in two rocket flights to photograph the sun in the near ultraviolet. Mr. Verdone's report on the equipment and its performance appears in the March 1967 issue of **Applied Optics.** The entire project is covered in a paper called "Rocket Spectroheliograph for the Mg II Line at 2802.7 A" by Kerstin Fredga.

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suppose as predators ourselves, we admire other animals of this ilk, and make the lion "king of beasts." But personally, I had much rather be bitten by a mosquito than by a lion.

I have been writing about man's food relations—about eating and being eaten—from the biological point of view. I have been writing, in other words, as though culture, ideas, attitudes, and tradition did not exist. But the behavior of *Homo sapiens* is always modified by his conceptual environment, and this must go way back in time, perhaps even to those australopithecines studied by Raymond Dart and L.S.B. Leakey. Ideas, however, leave few fossils, and we can only guess at their influence on the food habits of early man. With living peoples the influence is obvious and pervasive. I think one could say that no known culture uses the food materials present in the environment strictly in terms of availability and nutritional value. No culture is entirely "rational" about food.

I remember once, in the llanos of eastern Colombia, sitting around a fire eating toasted ants—the sexual forms that happened to be swarming in great numbers at that time. They had a pleasant, nutty flavor, and in season were sold at the local movie theater, serving the same function (and having the same effect) as popcorn with us. I happened to remark to my ant-eating friends that in my country people ate the legs of frogs —an idea that they greeted with horror. It was as though I had spoken of some immodest sexual activity. This may have been the beginning of my interest in the curious parallels between the cultural controls over food and sex—finally resulting in a book due to be published this fall with the title *Gluttons and Libertines*.

There is no evidence, as far as I know, that any of the food taboos are based on factual observation of ill effects (I am not classing the avoidance of poisons as "taboos"). It is sometimes said that the Jewish and Moslem taboo on pork has a basis in the danger of infection by trichina. But this looks like reasoning after the fact. It is more likely that the taboo started as a reaction against a heathen pig-cult that was once widespread in the Mediterranean region—only the worshipers of false gods ate pigs. Sometimes it is argued that the avoidance of pork has a basis in the filthy, scavenging habits of pigs, but chickens have equally filthy habits (from our point of view) and are eaten by peoples who reject pork.

Frederick Simoons has written a book on meat taboos in the Old World with the title *Eat Not This Flesh* (University of Wisconsin Press, 1961). He points out that chickens and eggs are about as widely tabooed as pork, although by peoples who have been less well publicized than the pork-avoiders. This taboo is particularly strong among many African tribes. Chickens most commonly are prohibited for women, but in some tribes they may be prohibited for everyone or for certain ages and social classes. They are frequently thought to be a cause of sterility, but a variety of other reasons may be given for the avoidance. Chickens and eggs often have religious significance, and chickens may first have been domesticated for purposes of divination rather than for eating. Cockfighting may also have sacred aspects, though it appears to be a trait of civilizations rather than of primitive tribes.

We are apt to feel superior to people who refuse to eat good food like chicken on superstitious grounds. But we have plenty of food taboos ourselves. One of the strongest of these is the taboo on eating dogs, though in many parts of the world dogs are raised for food, and in classical antiquity roasted puppies were considered a great delicacy.

The strength of the taboo is shown by an account given by Simoons in his book: "A good illustration is the recent case of Andrew O'Meara, a United States Army officer, who killed, skinned, and put a stray dog on a spit in Peoria, Illinois, to demonstrate means of military survival to some friends. He was prosecuted under an Illinois statute against cruelty to animals, pleaded guilty, and was fined the maximum $200 permitted by the statute. An interesting aspect of the case is that though Lieutenant O'Meara killed the dog with a sudden blow, and could have pleaded innocent, he felt public pressure sufficiently to plead guilty and to accept by agreement the maximum fine. The judge in the case received crank letters and threatening phone calls, one from as far away as Washington, D.C., to make certain that he 'did his duty.' "

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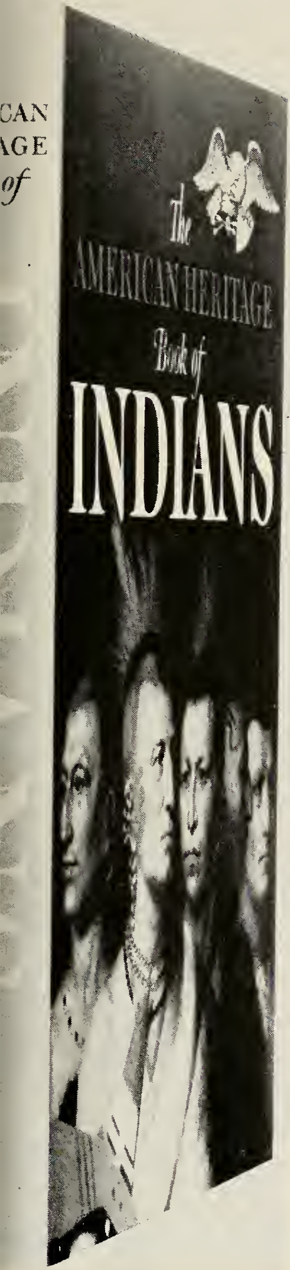
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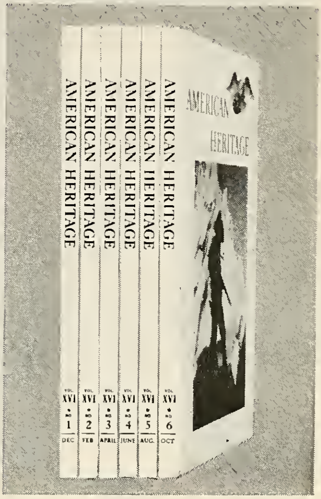
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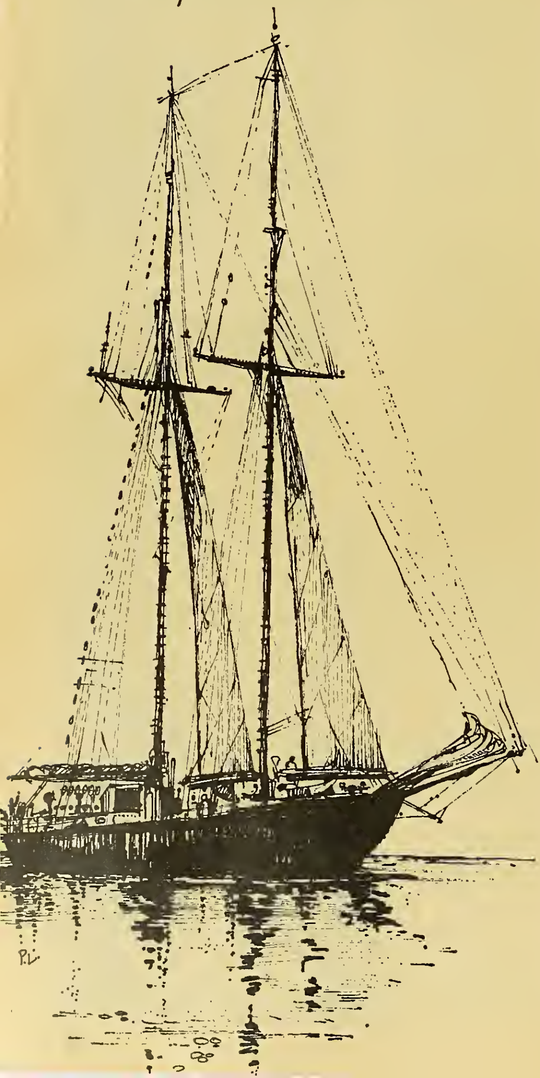
From the Log of the "Te Vega"

BY ROLF L. BOLIN



As the ship slips westward under straining sails, on suddenly notices that the gray-green water typical the California coastal reaches has been replaced by th clear, deep blue of the open Pacific. This is water th has remained on the surface for a long time, movin slowly with a far-circling current—the ocean's centr gyre. In an earlier, long-past period its burden of pho phates, nitrates, and other nutrients had been incorp rated into burgeoning populations of diatoms and din flagellates. These tiny floating plants of the surfa layers had, in their astronomical numbers, discolore the sea; then they died and sank, leaving the surfa waters an uncontaminated blue.

While sinking, the organisms were subjected to th complex chemistry of bacterial decay: they yielde their substance into solution in the sunless dept where no green plants can grow. At some distant pla of upwelling along the margins of land masses, where ocean currents diverge, this deep water wi rise into the sunlit superficial layers, and the effec will be similar to those seen when a farmer fertiliz his fields. Under the influence of nutrients that ha once more become available, tiny floating plants wi again multiply at a fantastic rate. The water will b come opaque green, as we saw it yesterday, or yello or, perhaps, as red as tomato soup. The plankt nets of oceanographers working in such an area w be clogged with microscopic plants, with herbivoro copepods that feed on them, and with carnivores th feed on the copepods. Fishes will abound, and trolli lines will yield albacore or bonito, dolphin or barr cuda, the final links in the oceanic food chain.

The striking contrast between the color and tran parency of today's water and its appearance when sailed through it only yesterday provides the first le son for the students on the *Te Vega*. The eviden of skimpy versus previously rich catches with t plankton net proves that we have left a comparative rich region for barren waters, and this is confirm by the limp trolling lines that trail astern, never sna ping taut to a hard strike. The facts, clear to anyo who has eyes to see, and interpreted by the seni scientists against a broader background than can observed at one time and place, bring home to ever one on board the basic plan of the general nutrie and food cycle in the sea. This kind of teaching h an impact that lectures and assigned readings alo could not even approximate.

Te Vega *is a graduate school at sea, dedicated research and training in biological oceanography. A quired by Stanford University, this 135-foot, ste hulled, two-masted schooner was converted in 19 and is operated with funds provided by the Nation Science Foundation. In the past four years she h carried over two hundred researchers and trainees sea. During four eleven-week periods each year s serves as classroom, research laboratory, field statio and home-away-from-home for a scientific party co sisting of three faculty members, ten graduate studen and two marine technicians, who have been recruit* *m universities throughout the United States.*

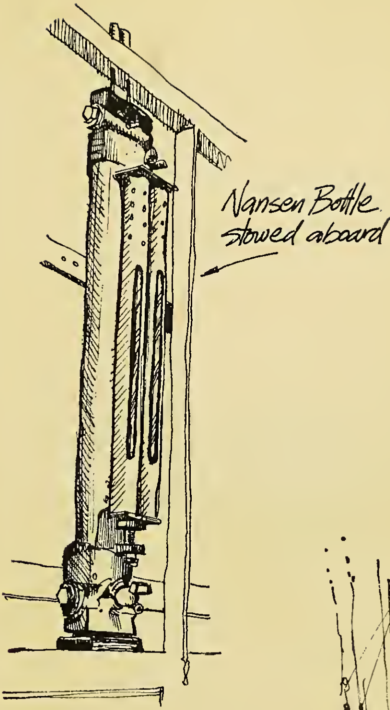
This is the latest in a succession of roles played by Vega. *Back in 1930 she was built by Friedrich upp in Germany as a yacht for a millionaire's wife. ter, she was bought by Cornelius Crane, the plumb- g tycoon. In World War II the U.S. Coast Guard nmoned her to duty as a patrol ship (on one occasion enemy submarine thought her too unimportant to pedo). In 1956 she was featured in the Cinerama vie* South Seas Adventure; *in 1959 she became a ury cruise ship.*

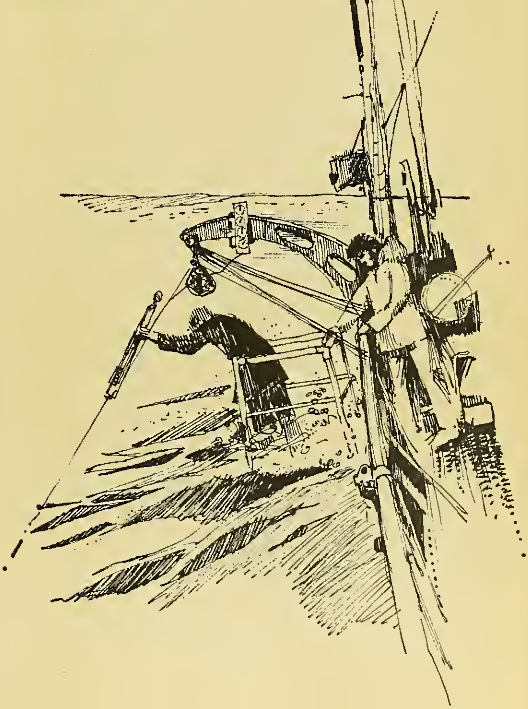
Today she is equipped for adventure of the scien- c kind, investigating the life process in what we l the oxygen-minimum layer off the Pacific coast of Americas. Fitted for a broad and varied program study, she boasts wet and dry laboratories, loran, leep-sea precision fathometer, sonar, hydrographic l deep-sea trawling winches, bathythermographs, nsen bottles (with attached reversing thermometers) deep-water sampling, titration equipment, spectro- otometer and induction salinometer for water chem- y, nets of many different kinds for biological npling, gimbaled aquariums for laboratory observa- n, and diving gear for invading the ocean itself.

It must be admitted that a sailing ship is not the al vessel for modern oceanographic work. Te ga's *beautifully tapered hull and wineglass cross sec- n restrict the space available for berthing, labora- ies, and stowage, and her sail booms preclude the lition of such space by building the deckhouses her. The clutter of standing and running rigging its the working room and restricts us to using tively small and light gear. We are unable to mount ge drums for long lengths of electrical cable that uld permit time-saving, direct readings from* in *sensors. The 17-foot draft limits operations in y shallow waters.*

But there is one splendid compensatory feature. Te ga's *low freeboard places the scientist in intimate ation to the sea; it is almost as if he were standing its surface. He can see any organism in the upper ers and can often reach out with a dip net and cap- e it. He is practically part of the environment he dies. Alumni of the cruises leave with a deeper ling of intimacy for the multiform organisms of the ad ocean, a more profound appreciation of the nplexity of the milieu in which these live, and a ater respect for the changing moods of the sea n can come to those who work on larger and more dern vessels.*

Before Te Vega *was ready to assume her planned vities in the eastern Pacific an opportunity arose her to participate as one of the American vessels in International Indian Ocean Expedition, a multi- on study of that least known of oceans. Since this vided a chance for operations in distant waters oth- ise beyond* Te Vega's *reach, it was immediately sped. As a result the ship roamed into many places, h well known and almost unheard of: Pago Pago Tikopia, Singapore and Kutaraja, Gan and Mau- s, Mutsamudu and Mombasa. On their way to the*





Indian Ocean the ship's scientists were already having experiences and adventures far too numerous to relate. Perhaps a few gleanings from the wake of Te Vega's *passage will yield vignettes that impart some impression of what it was like.*

Bountiful Raft

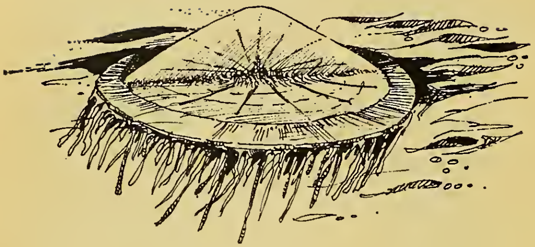
We are in the clear, barren waters of the open North Pacific, but just how barren are they? A small blue oval, about an inch long, is noted floating on the sea surface. It passes astern and out of reach, but soon we see another. The long-handled dip nets are manned, and before long we have on board a "by-the-wind-sailor." This is *Velella,* a pelagic hydroid colony. It consists of the principal individual, the buds for new ones, and characteristic paraphernalia. We see that the oval is a transparent chitinous plate, which floats raftlike on the surface of the sea, and from which a plate of the same material rises perpendicularly to form a sail. Around the margin of the oval a fringe of blue tentacles hangs from a band of blue tissue. The underside has a large feeding polyp in the center and is elsewhere covered by a complex mass of tiny, brownish spheroid bodies—the buds that will later go free. A beautiful and intriguing creature indeed. We continue fishing and specimens soon cover the water in one of *Te Vega*'s aquariums.

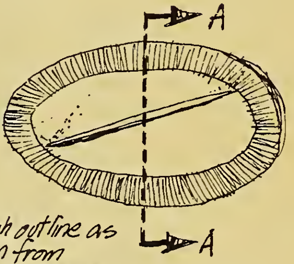
As we sail onward *Velella* gradually becomes more numerous and the individuals larger—we gain the impression that we are watching the population grow older. The inch-long ovals that we first encountered have been replaced by *Velella* in the prime of life. The ovals now reach an average length of more than three inches, and are so abundant in some areas that we estimate more than one per square yard. We note also that if the long axis is considered to extend from north to south, the sails invariably extend along a NW to SE diagonal. The books state that this is not always true, that some have sails extending from NE to SW, and that this difference disperses the floating colonies over the sea surface by sending them on different tacks. If so, the wind has already done its work, sorting out *Velella* and leaving us only those with sails on NW-SE diagonals.

In our aquariums some of the specimens are now dropping their brown spheroids, and we hasten to examine these under the microscope. The freed buds turn out to be small jellyfish without any trace of tentacles: they are simply pulsating bells. Such modified medusae cannot eat; their sole function during their brief, independent existence is sexual. If the eggs and sperm that they shed into the water should unite, each resulting individual will then asexually reproduce the varied individuals of a new *Velella* colony such as the one we first encountered. This method must be successful, for *Velella* are spread over 400 miles of our course, and we have no idea how far to the north and south the population limits lie. The number of *Velella* must certainly be counted by the billions.

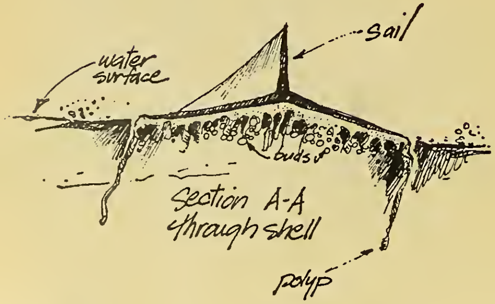
Continuing our course, we notice other organisms that are associated with *Velella.* First we catch the

Velella
"by-the-wind-sailor"





rough outline as seen from directly above



Section A-A through shell

agic snail *Janthina.* The delicate shell is almost ite, but the animal is the blue of the sea. Clinging *Velella* or suspended from its own intricately fash- ed float of air bubbles imprisoned in mucus, *Jan- na* becomes more and more common, and we soon serve that there are two species. They differ not y in the structure of their shells but in the shape he bubble floats. When irritated sufficiently by pok- , the snails liberate a beautiful reddish-purple dye. th this, it has been reported, *Janthina* narcotizes *lella* before eating it. We detect no narcotization do find plenty of evidence that *Janthina* eats *lella* with great gusto.

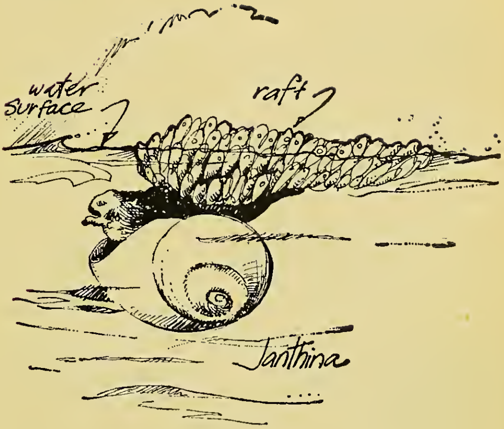
Next, the nudibranch *Fiona* is noted crawling und on *Velella.* This shell-less snail, with feathery s of cerata covering its back, looks peaceable—and t. We soon become aware that it is a voracious ature, devouring the entire *Velella* with the excep- 1 of its raft, upon which *Fiona* then commits the l indignity of depositing its eggs. Then we are are of still another predator, a small grapsoid crab ut the size of a sugar cube. It looks ridiculously of place here in the open ocean, but judging by the nber found, it feeds well aboard its living raft.

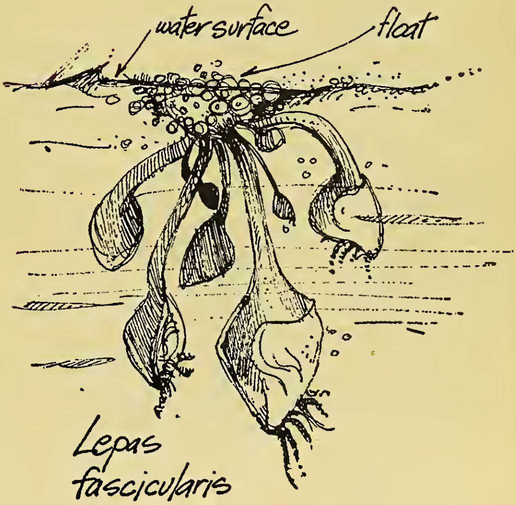
The final conspicuous member of the community is *as fascicularis.* This barnacle, with shells reduced aper thickness as an adjustment for the floating life, les on *Velella* as a metamorphosing larva and is n joined by numerous relatives. Eventually they y form masses larger than a man's head, hundreds ndividuals that extend in all directions from a gas- taining communal float in which the original sup- ting *Velella* seems entirely lost. These barnacles not as shy as the coastal representatives of their us, which withdraw into their protective shells at slightest disturbance. Instead, the sea-faring bar- les extend their feathery tentacles (actually modi- legs) and try to engulf a probing finger—eloquent lence that they must take advantage of whatever d presents itself in this famine-prone habitat.

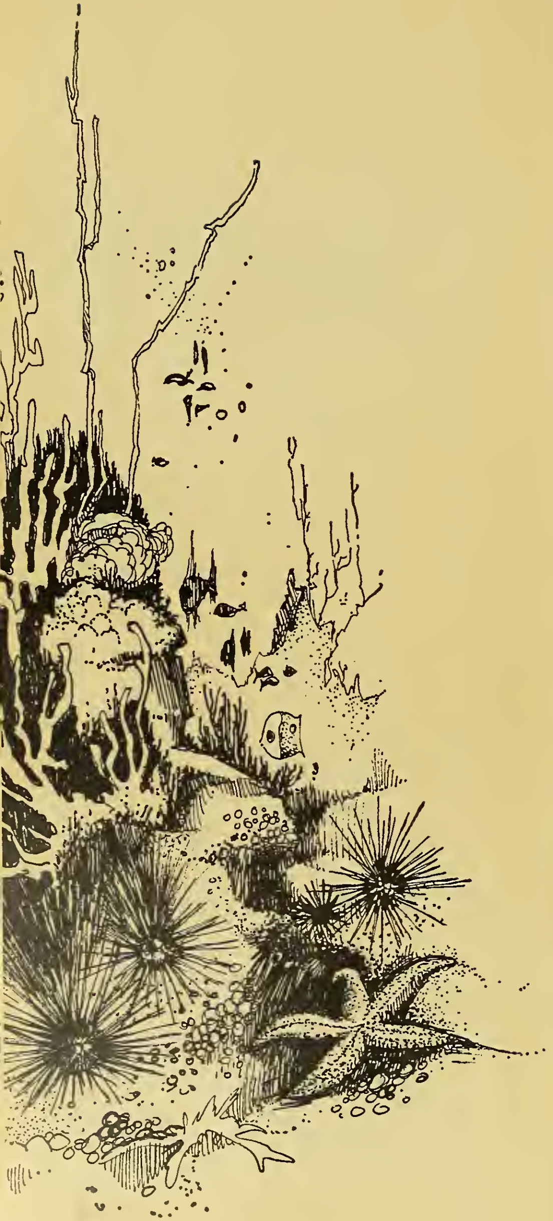
By the time we leave *Velella* behind, we have a r concept of this animal community. It is wonder- y simple, uncluttered by hundreds of species—and ations in the environment do not confuse the pic- . First, we saw the youth of a population, consist- of one dominant form, exploiting the sparse plank- of the open ocean. As we sailed into older portions he community we observed it developing into ma- ty and then becoming subject to attack by several ls of predators. As these increase in number, and *Velella* becomes senescent, they eventually kill the se that laid the golden eggs, thereby bringing ex- tion to themselves.

Down in Coral Fairyland

Ve have come to Vanikoro, in the Santa Cruz Is- ls (part of the Solomon Islands chain). Now half ozen of us, equipped with air tanks and breathing aratus, with face plates and swim fins, cavort in ect ease and comfort at a depth of forty to fifty , while others from *Te Vega* snorkel in the surface







layers and await their turn to use the breathing equipment. Weightless in the clear, warm water, unworrie about personal orientation, we glide slowly and almo without effort in any direction while the fantasti panorama of the reef streams past our eyes.

Huge rounded monoliths of coral ten feet in diameter appear soft and iridescent green until a probin hand causes their polyps to retract; then the mass suddenly stone hard and dark brown. Small fishe inch-long gobies matching the polyps in color, scurr over the hard surface as we drift by. Parrotfishes fee on small coral heads, and the sound of their chisel-lik teeth scraping shallow grooves in the coral sets ou own teeth on edge. It also leads to the thought tha chewing up rocks is a poor way of making a living.

Here rise rich gray vases of coral; there, fragil golden-yellow platters, or shelves, jut out from vertica walls. Beautiful shell-pink hydrocorals grow in th form of tiny grotesque trees, while great thickets o branching white staghorn coral display bright blu tips on every branch. Relatively small *Tridacn* clams, only a foot or so in length, lie almost embedde in the coral, but extend their mantle edges of mottle green and blue and brown out into the light so tha the symbiotic algae living in their tissues can thriv Black sea urchins with foot-long spines presen needle-like hazards to the unwary diver. Tube worm of various kinds display circles of brightly colored an banded tentacles, which magically vanish in a flas when disturbed by an approaching hand or even th passing of a shadow. Red or blue starfishes crawl ove exposed surfaces; black crinoids, or feather stars, hid in crevices and, when disturbed, swim away in graceful slow-motion ballets.

It is tempting simply to drift slowly around in th fairyland, observing its wonders, but we are here o more serious business: our job is to make a collectio of fishes from the reef. A few short years ago the ston lacework and protruding fingers of the coral provide such an efficient device for the destruction of ne and so perfect a refuge for the fishes that it was impossible to collect an adequate sample of the ree fauna. Now the producers of chemical insecticide have come to the aid of the ichthyologist, and w are able to do the job.

We find a place where there is a depression extending into the reef wall from the lagoon side. We hav selected the time of slack water, so in this hollo the tidal current is now almost absent. Into one-qua polyethylene bottles we have poured a black, oil concentrated solution of rotenone. Applying sudde pressure to the sides of one of these squirt bottles send out a puff or sometimes a smoke ring of poison. Th area is then quickly obscured by a dense opaque clou which reduces visibility to two or three feet. In th way a diver lays down a lethal curtain in a half-circ around the spot we have chosen.

Rotenone has a good reputation because this plan derived poison is relatively harmless to birds an mammals. For example, swimmers submerged in feel no ill effects beyond a very slight puckering of th os. With fishes, the effect is more striking because tenone is a vasoconstrictor that affects the capillaries their gills. Within five minutes, fishes begin to reel it of the cloud on drunken, erratic courses. Our chase gins. Some of us are surface swimmers, others are vers, but we all carry short-handled dip nets for ooping up the specimens. We confine them to the t's long mesh bag by a half-twist of the handle, so at others can be pursued. The pace is furious—hes of all sizes, shapes, and colors are tumbling erywhere. When one of us finds his net is full, he kes it to the diving boat, to be emptied into plastic rbage cans containing the preservative Formalin. hen he returns to the chase.

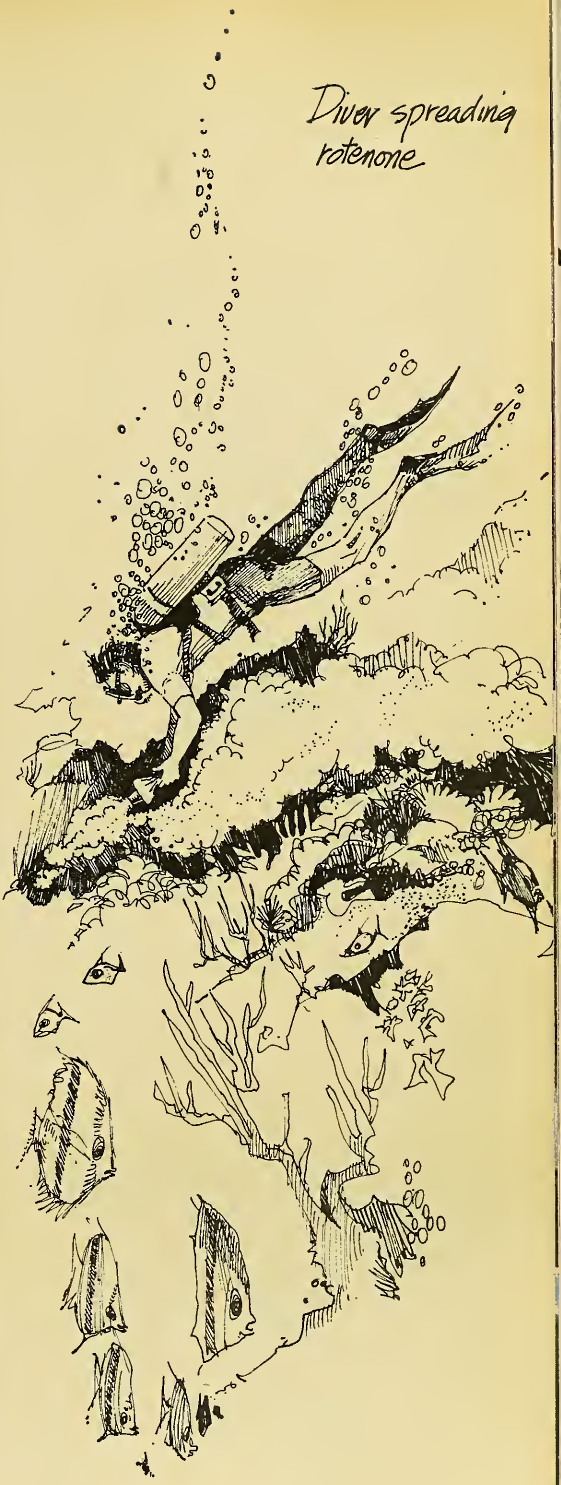
Different groups of fishes display different degrees susceptibility. First to be affected are the damselhes. These are soon followed by cardinal fishes, butrfly fishes, surgeonfishes, and many others. Eels are nong the most resistant forms; some species require r using a second shot of rotenone and waiting more an an hour before they crawl out of their holes. Long ter the poison cloud has dispersed, the collecting ntinues. Swimmers scan the surface for fishes that e floating and drifting away. Divers search the botm for those that have sunk and accumulated in slight pressions.

Our catch has been good: more than 150 species. e have collected a large series of many types of ecimens, which helps us study the normal limits of riation among them. It is unfortunate that in securg what we consider to be an adequate sample of the mplex fauna we have killed many more fishes than have been able to take. However, they have not en wasted, and the reef has not been seriously arred. Long before we have finished our collecting have been in competition with birds and with inding fishes, crabs, snails, and other organisms from ljacent areas. Their objective is the unscientific one eating up our specimens. At any rate, so great the pressure of the teeming life of the coral reef at within an hour of spreading the poison the fish pulation appears to be just as great, diverse, and lorful as it was when we arrived. In practically no ne at all, our disruption of the ecological balance s been repaired.

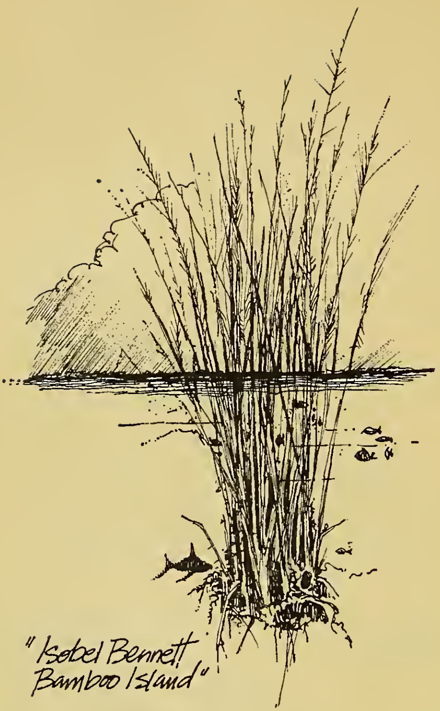
On our return to the ship we face the tedious task washing the catch, cutting a slit in the abdomen of ch fish longer than a couple of inches so that the eservative can enter the body cavity, and straighting out each specimen for hardening. After about rty-eight hours it will be carefully labeled, wrapped cheesecloth, and packed away for dispatch to the nithsonian Oceanographic Sorting Center—for evenal dispersal to specialists throughout the world.

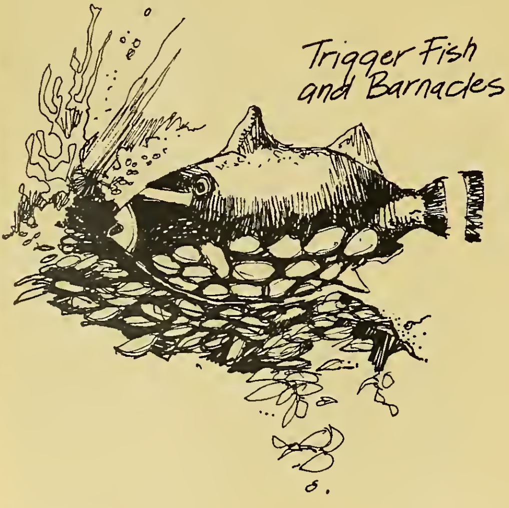
The Wandering Island

New Guinea lies below the horizon to the south. ierefore, for us, it does not yet exist. We are alone a flat blue mirror extending to the limits of the iverse—or so it seems. An infinity of water and sky: that all that exists? Not quite. Far to the north a



Diver spreading rotenone





tiny speck of something is spotted on the horizon, and *Te Vega* alters course to investigate.

Three-quarters of an hour later we are alongside Isobel Bennett Bamboo Island, so named for its discoverer. This is no fixed land mass. Rather, it is a drifting islet with something more than fifty stalks o bamboo extending about twenty-five feet into the ai and an equal distance down through the clear wate to a large ball of earth and matted roots. This ball acts as the sinker that keeps the entire complex erect.

As soon as we have tied up to our little island an aggressive population of ants begins using the mooring line to invade the ship. We see here a mechanism for the marine transport of terrestrial animals, and are led to ponder the problems of zoogeography Countless voyages by animals of all kinds on bits o drifting vegetation have ended in disaster as suitable food ran out or as the rafts became waterlogged and sank. Sometimes, however, the voyagers have stranded on hospitable shores, and in this way they have been able to occupy and exploit a new island, perhaps even a virgin continent.

Nor do only terrestrial forms expand their range in this way. Of many marine animals living along the shore, depending for survival on the shelter provided by the bottom, it is not unusual for some to become associated with bits of debris. When these drift away from shore, they transport their consorts off to distant parts. We have often dipnetted bits of flotsam and thereby, all unknowingly, captured associated fishes or other organisms. For instance, some three weeks before reaching the bamboo island we scooped up a bi of drifting pumice that had undoubtedly been washed out from Fiji, fifty miles away, by heavy rains. It was about the size of a large grapefruit, jet black in color and speckled with small white lepadid barnacles abou two or three millimeters long. Perched on the low-density rock was a small shore crab off on a journey to great adventures, but more interesting was the three-inch triggerfish that we acquired at the same time. The fish was black and marked by white specks just the size of the barnacles and spaced about as they were. After transfer to the aquarium the fish always stayed close to the floating pumice and often pressed directly against it. At such times it was practically impossible to distinguish the fish at a distance of one foot, so perfect was its protective coloration. There could be no doubt that the pumice offered critical shelter, or that wherever it drifted the fish would be forced to follow.

And our little island? It has a large number of fishes flitting through its misplaced tropical forest, and we decide that it would be a good idea to sample them Out comes our gear and soon rotenone is being spread from one of our small boats. As the fishes begin their groggy gyrations we slip into the water to scoop them up, but success will not be ours. Almost immediately six-foot sharks appear from nowhere to dispute ou claim to the fishes, and while some divers may ignore the danger of sharks, we abandon the field. Lurking around the drifting island, the sharks must have been frustrated innumerable times when the swarm of fishes ught perfect refuge in the impenetrable thicket of ugh bamboo, and we have no desire to tempt them th juicy human hams. We try to pick up a shark as onsolation prize. But after twice having one on the e and then unsuccessfully trying to bring it on board, leave empty-handed.

Probing an Indonesian Bay

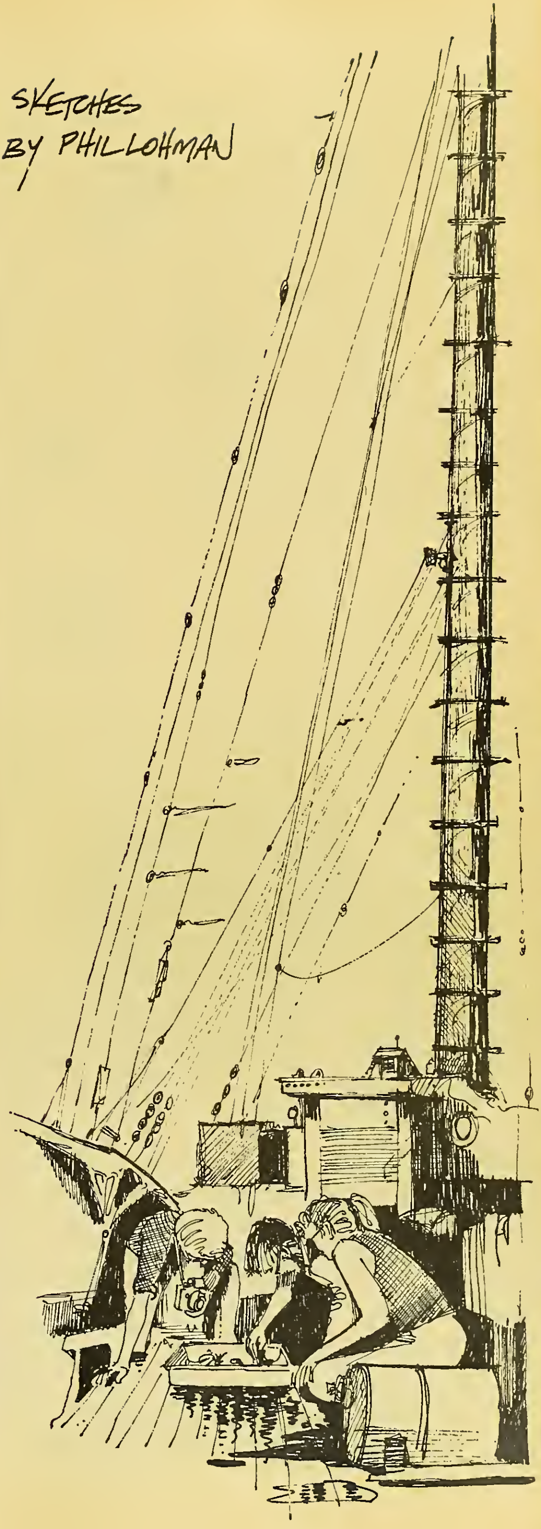
Some 300 miles northwest of New Guinea the great y of Teluk Kau cuts the Indonesian island of Hal- hera almost in two. We are near the head of the bay, king with our fathometer for the deepest water it n find in a basin. The chart shows this basin sepa- ed from the deep water of the outer bay by a sill it comes up to within 150 feet of the surface, and are anxious to examine the effects of this rise on logical conditions in the basin.

After a little probing locates a depth of 1,500 feet, send down a series of Nansen bottles. As soon as read the reversing thermometers we can see that s station will not yield a normal temperature profile. re is no marked decline in temperature with increas- depth of the water, no differential of almost 33 grees Fahrenheit between the surface and the bot- n, such as occurs on the outer side of the sill. In the sin the temperature continues uniform below a oth of 300 feet, and the total difference between dings at the surface and those close to the bottom is s than one degree.

Chemical analyses corroborate the temperature a and show how importantly the rising sill regulates drographic conditions in the deep water of the basin. inity, oxygen, phosphate, and silicate curves all dif- from those of the open ocean; they show either tical profiles or reversed trends.

Hydrographic conditions have a direct influence on rine life. Before the chemical analyses are complete, have made a haul with our bottom trawls and ught on deck a surprising mass of decaying vege- le matter—but practically no animals. Only a few all worms and some tiny isopods are burrowing into debris. Yet on the other side of the sill, the bottom omparable depths is composed of clean green mud l supports a heavy population of mollusks, shrimps, bs, and fishes. We should like to spend weeks in- tigating these intriguing contrasts. But our com- ment in Singapore forces us to push on.

These brief sketches attempt to convey what the ex- ience was like for graduate students aboard Te ga. *To really know what it was like you would have have been with us: standing biological watch on k in the blazing sun or drenching downpour; doing mical determinations while fighting for balance on a ted, heaving deck; marveling at the fantasy of a al reef with the aid of an aqualung; trying to con- trate on a lecture while sweat dripped off your nose l the note paper stuck to your arm; ogling the ches as they came up full of treasures from the dark ths; doing a thousand things that you will remem- forever.*



SKETCHES
BY PHIL LOHMAN

The Glossy Ibis
has exhibited chang
in nesting,
breeding, and habitat
that have enabled
to adjust to a variety
of living conditio

by Helen Hays

The Adaptive Ibis

In 1961 it was discovered that Glossy Ibis, *Plegadis falcinel* was nesting within the boundaries New York City, just southwest Kennedy International Airport. T species, which until recently had o been found breeding in a relativ remote area in southern Flori quite suddenly took up residence the shadow of one of the busiest ports in the United States. The N York City nesting ground is now northern limit of the bird's breed range in this country and marks culmination of a dramatic range pansion by this species, which t place between 1955 and 1961.

Several times during the 1940's and early 1950's, conser tionists had been concerned w severe drought conditions in Flor forced many of the Glossy Ibis n Lake Okeechobee to desert the a Their fears were apparently founded because this was the o known breeding ground of th birds in the United States. Furt more, it was generally agreed t the species was non-migratory in Western Hemisphere, and it was lieved that the drying of the O chobee marshes might seriously duce the breeding population.

The Glossy Ibis, however, exhib- ng an unexpected adaptability, emed to solve its own problem. One st was reported in North Carolina 1940, and another in 1947, indi- ting that certain individuals had en able to nest away from the con- ntration at Lake Okeechobee. Then, tween 1955 and 1961, the species' pability of pioneering in new areas as clearly indicated as breeding irs were reported in heronries at veral localities scattered along the ast Coast, north of Florida. Birds sting north of the Carolinas tended migrate south in the winter, while ose nesting in the Carolinas and orida were apparently permanent sidents. Following these initial re- rts, the Glossy Ibis continued to quire new breeding sites, and the mbers of nesting birds observed in ch of these areas increased rapidly.

The sharp increase in nesting ibis the New York City area is typical the rapid expansion of the species all of its coastal nesting sites. In 61, three nests were found in the maica Bay Refuge, where the ac- mpanying photographs were taken. wo of these were in a heronry and e third in a nearby marsh. The site as not checked again until the ring of 1965, when twenty pairs ere spotted in the refuge and thir- en pairs were reported a short stance away.

On a brief visit in late May of 65, I was able to locate two Glossy is nests with eggs in the Jamaica y Refuge. On July 10, a more reful search revealed a total of teen nests. Strangely, only one of ese contained young ibis, while the mainder contained still unhatched gs. From what records were kept the species, July seemed a late te for nests to contain unhatched gs, particularly when at least part the flock had obviously been breed- as early as May. An explanation ered for these late nests was that ds that had nested unsuccessfully the early part of the season were w making second attempts.

Ibis nests in the refuge are of two es. One is bulky and made of ny pieces of *Phragmites*, the tall spy-topped marsh reed commonly n in wetlands. The other is a plat- m of sticks, lined with a few reed tops, on which the deep blue-green eggs are laid.

In addition to building their own nests, Glossy Ibis are known to utilize stick nests built by other species. The groves comprising the rookery at Jamaica Bay are small and are occupied by dense populations of Snowy Egrets (*Leucophoyx thula*) and Black-crowned Night Herons (*Nycticorax nycticorax*), both of which build stick nests and begin nesting earlier than the ibis. A dearth of sticks probably forced some of the ibis to use *Phragmites* for nesting material and to occupy the stick nests of other species, to which they added a few wisps of *Phragmites* before depositing their eggs.

By 1966, the Jamaica Bay ibis, undergoing a minor population explosion, had constructed some seventy nests, all of which contained eggs by late April or early May. Some of these were built on the ground, the first time that this species has been known to nest other than in trees and shrubs. Since most of these young hatched successfully, the fifty new nests containing eggs, found in July, suggest that many pairs of Glossy Ibis nested twice within the same season. This would explain the dramatic increases in the species in their newly inhabited coastal sites.

Young Glossy Ibis have black skins and down; their bills are flesh color, striped with dark bands; and there is a white patch on the forehead. For the first ten days or so they appear lethargic, except when the parents come to feed them. During this period, the bodies increase in size at a much greater rate than the heads, giving them a ludicrous, lumpy appearance. At about two weeks of age, they begin to walk about in the nest, and at the same time begin to show fear of human beings. By the fourth week the birds are able to make short flights, but still return to the nest to be fed. Once the young are able to fly well, they can be seen feeding with the adult birds away from the rookery.

Glossy Ibis, especially juveniles, often wander great distances during the post-breeding period. In 1956, for instance, a young bird banded on June 21 in a rookery on Hog Island, Virginia, was recovered on September 17 at Ile aux Grues in the St. Lawrence River, 850 miles north of the banding site.

The species feeds on a variety of animal life, including large insects, worms, crayfish, frogs, and snakes. That they do eat reptiles when available may explain why these birds were appreciated by the ancient Egyptians. The Glossy Ibis, as well as the Sacred Ibis (*Threskiornis aethiopica*), probably helped keep the gardens of the royal palace free from dangerous snakes. The Sacred Ibis was apparently revered by Egyptian nobility, and many were entombed with deceased Pharaohs. Occasionally Glossy Ibis were also honored with entombment, as recent findings have shown.

Although no longer breeding in Egypt, the Glossy Ibis is found nesting in other parts of Africa, tropical Asia, and southern Europe. The best explanation of its appearance in the Western world is that birds in flight were carried across the Atlantic by northeast trade winds, a phenomenon that has played an important part in the displacement of other species. The Glossy Ibis was first recorded in this hemisphere in 1817, when one was collected in New Jersey. This individual probably wandered from the south, for Audubon and a number of other observers sighted the bird in Florida shortly thereafter. Not until the twentieth century were there any reports of the species breeding, when, in 1909, an Audubon warden on Orange Lake in Florida observed the first nesting pair. Only a quarter of a century later, some 1,200 pairs were reported nesting at Lake Okeechobee, a site that remained the breeding ground for Glossy Ibis on this continent until the recent drought conditions threatened the birds' existence.

In a period of a few years, the Glossy Ibis has exhibited changes in nesting, breeding, and habitat that demonstrate that the bird can adjust to a variety of living conditions. With its continental range now extending from Florida to New York, there is increased opportunity to observe this species and to determine the factors contributing to the population expansion now taking place.

Museo Nacional de Antropología de México

by Shirley Gorenstein

When the National Museum of Anthropology opened in Mexico City in 1964, anthropologists, who had been invited from all over the world to preview it, declared it to be a unique achievement. What was so striking was that the anthropological objects, and the structure that housed them, were united in a stylistic harmony—the one enhanced the other, affording a reinforced appreciation of each.

The museum is in Mexico City's well-known Chapultepec Park, and the natural setting permits the visitor to clear his mind of the many other architectural styles of the 400-year-old city. He is introduced to the new style by the huge figure of an ancient deity standing against the backdrop of a simple wall outside the museum proper. By the time he walks through the entrance plaza and the lobby into the expansive courtyard, he is immersed in the style. When he leaves the courtyard and moves in and out of the exhibition rooms that surround it, he understands that the style of the modern museum is infused with the esthetic mode of past cultures and ancient objects. The impact of the unity is profound. The anthropologists, in applauding this new museum, not only acknowledged the excellence of the architecture, the clarity of the exhibition arrangements, the variety and beauty of the artifacts, but they were also deeply moved by the totality of the esthetic experience.

Why have the Mexicans been able to bring stylistic harmony to their anthropological museum while others have not? The answer lies in the history of archeology and anthropology. When archeology became a discipline in Europe in the nineteenth century, its aim was to recover the ancient past. All of the past? Not at all. Archeologists sought to understand the past of *their* world, the Western world, and that past was then discernible

photographs by Lee Boltin

The huge, imposing figure of Tláloc, the god of rain and lightning and a major deity throughout Mesoamerica, stands majestically outside the museum.

only in the civilizations of the ancient Near East, classical Greece, and Rome. The Paleolithic, Mesolithic, and Neolithic cultures of the Old World were so distant in time, so primitive in content, that they seemed unconnected to European civilization, and their study was relegated to the province of a special kind of archeologist, the prehistorian.

At the same time anthropology was coming into its own as a discipline. Its aim was to study non-Western peoples. In the New World the study of the American Indian led back quite naturally to the pre-Columbian inhabitant of the hemisphere. And so the archeology of the New World, ranging from the earliest man to the complex civilizations of Mexico and Peru, was put into the hands of the anthropologists. Then a curious line was drawn by the archeologists of both the Old and the New World. They were themselves products of the Western intellectual world, and they saw two cultural traditions: one was directly antecedent to the Western world (that of the ancient Near East, classical Greece, and Rome); the other could only be defined as that which was not.

Two kinds of museums developed that reflected this dichotomy: art museums and anthropological museums. The art museums represented the Western tradition from the earliest Old World literate civilizations until contemporary times. The museum architecture, whether revivalist or contemporary, expressed some aspect of that tradition. A sense of harmony was achieved in the historical relationships between the objects themselves, and in the relation of the objects to the museum. But what strange bedfellows turned up in anthropological museums as a result of such an ethnocentric view;
pebble tools of early man, feathered headdresses f
the American Plains, wooden figures from West Af
and architectural models of the temples of New W
civilizations. This lack of relationship between
objects was confusing, and the contrast of styles
ring. Moreover, these products of non-Western cultu
past and present, were housed in museums architec
ally not unlike the art museums. This dissimila
between architecture and art reflected and maintai
the view: we of the Western world are looking at
of the non-Western world.

The marvel of the National Museum of Anthropol
of Mexico is that the same division between the
worlds is not made. The Mexicans have come to see t
culture as the synthesis of two traditions: the pre-Hisp
ic Mexican and the European. At the outset they cl
to take from their old museum on Moneda Street
the indigenous Mexican material. All other anthro
logical exhibits were left behind. The new museum
to trace the indigenous Mexican tradition, from pas
present. A new distinction had been made, not betw
the Western and non-Western worlds, but between th
worlds that have a historical and cultural connection
those worlds that do not. The force of this contin
is felt by the chronological arrangement of the mate
from archeological past to ethnographic present an
the display of it artistically and architecturally so
there is no interruption in the stylistic feeling betw
ancient and contemporary Mexico.

The architect, Pedro Ramirez Vasquez, in wri
about the museum delineated what were for him
influential aspects of ancient Mexican architecture.
sees in his pre-Hispanic predecessors a sensitivity
the landscape, and a feeling that architecture
achieve a harmonious relationship with it. He un
stands that their architecture accommodated the
formance of great rituals: horizontal planes were
to create the huge, open spaces where the celebr
gathered, and vertical planes for the monumental sc
ture that linked heaven and earth. He is struck by
use of façades as separate structural elements an
the interplay of varying textures of stones. He fo
the park setting congenial. The landscape is respe
and incorporated into the building's design. The v
tation of the park frames the entrance plaza, and sc
tures have been placed in gardens before a backgro
of lush, green plants—much as they stood long ago

The building has a rectangular plan. Essentially th
is a large central courtyard, and around it are the e
bition rooms on ground and upper stories. The lay
continues an ancient tradition in which an open s
is bounded by enclosed rooms. The courtyard exem
fies the beautiful synthetic style of the museum. Th
are two areas. One is unroofed and has a simple
with a huge bronze conch shell, an ancient symbol. I
ing the day the light here is white and brilliant.
other is partly covered by an "umbrella roof," wh
floats above the upper story. The roof is cantilev
from a monumental, bronze central column, which
tends through the circular opening upward toward
sky. Rainwater drains from the roof and falls thro

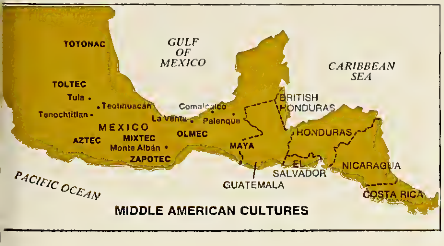
e opening (water is piped through artificially when ere is no rain). It is cool and dark under the roof, and nding anywhere in the shaded area one is touched licately by the spray from the waterfall. The sharp ntrast between the two areas of the courtyard mirrors e contrast of the climate in parts of Mexico during the iny season—the intense sunlight of the late morning d early afternoon suddenly broken by the cooling instorm of the middle afternoon. Because the visitor ust walk through the courtyard to go from room to om, the natural world becomes an integral part of the splay. The sun and the rain were central elements in exican cosmology and the continuing tactile reminders he sunlight and the water—contribute to a powerful, otional appreciation of the religious sculpture, ually approached only intellectually.

The façades of most of the walls are stark and straight. riety is achieved through the use of stones with ghtly different tones of color. A part of the façade of e upper story is quite different. It projects beyond the e of the wall and appears as a separate structural tity; here the open stonework has a pattern that anges depending upon the light and the position of e viewer in the courtyard. This concept of a super- uctural façade comes from an ancient architectural dition that emphasized elaborate and intricate de- gns, and while the modern form is simple, the idea of ld wall ornamentation is continued.

ach exhibit room on the ground floor is divided into o parts. The entrance has a low ceiling and contains ckground information on the artifacts. In the farther tion the ceilings are twice as high. Moving from the aller section to the larger, the visitor has the sense of ming suddenly upon the objects—of discovering them. any artifacts are not in cases, and it is easy to walk ound sculpture and stand between objects. It is pos- le to be *among* them.

As soon as he enters the museum the visitor may go an initial introductory hall for a slide lecture on e-Hispanic culture in Mexico—from the earliest finds the Spanish conquest. Two other introductory rooms al, respectively, with anthropology as a discipline and th an analysis of Middle American culture as a whole. t, while the Mexicans are intent upon educating the sitor, native and foreign, they have also made the seum a center of professional study. Within its walls e housed the National School of Anthropology (which can accommodate five hundred students), the National Anthropology Library (with a quarter of a million volumes), and workshops and laboratories. In addition, storerooms contain many thousands more objects than have been put on display—the source materials for archeologists studying some of the still obscure aspects of pre-Hispanic history and culture.

The material of the museum is displayed in a chronological-geographical framework. The ground floor, divided according to archeological regions, deals with the pre-Hispanic period; the upper floor with the life of contemporary Indians from different parts of Mexico.



MIDDLE AMERICAN CULTURES

There is evidence of man in Mexico in late Pleistocene times; Paleo-Indian hunters of extinct mammoths, mastodons, horses, and camels. With the close of the Pleistocene, some 10,000 years ago, small game hunting and wild plant collecting replaced big game hunting as the major subsistence pattern. The period between 7000 and 2000 B.C. is characterized by increasing control over the food resources. Hunting and plant collecting gave way to the cultivation of such plants as the pumpkin, squash, bean, bottle gourd, and chili pepper. Specialized tools, the grinding stone and slab among them, were developed for the preparation of plant foods. By 2000 B.C. hybridized strains of maize were a staple crop, and these stable food resources aided in the establishment of permanent sedentary villages of one- and two-room houses made of poles or wattle-and-daub with thatch roofs.

At this time the cultural tradition of pre-Hispanic Mexico began to take shape. The tradition was not confined to the political boundaries of contemporary Mexico, but reached into the territory of what are now other Central American countries: British Honduras, Guatemala, El Salvador, and parts of Honduras, Nicaragua, and Costa Rica. The archeological area is called Mesoamerica (Middle America), hence Mesoamerican tradition, but it is nonetheless dominated by Mexico.

A firmly established argicultural subsistence and sedentary pattern permitted the development of culture by assuring a storable surplus and a stable population. Ceremonial centers became important. The flat-topped pyramid of earth and rubble and adobe was a basic architectural form, and it was used as a base for elaborate palaces and temples, which were faced with cut limestone masonry set in and covered by a limestone mortar, and sometimes decorated with superstructural façades. Crafts, particularly pottery making and stoneworking, proliferated. Religious ritual and theology were elaborated, to judge not only from the architecture but also from the masks, monumental statues, stelae, disks, and altars. Technological innovations led to intensive food production and thereby allowed the support of a large non-food producing population of specialists. The ceremonial centers were transformed into densely populated urban centers with differentiated and specialized economic, religious, and political institutions. The urban centers became the focuses of certain traditional elements of civilization, particularly the political bureaucracy that ultimately formed large tribute empires.

While Mesoamerica is a coherent archeological unit, it was nevertheless marked by variations in culture reflecting the considerable geographical diversity of the area. Within short distances there were (and are) major differences in landforms, climate, vegetation, soils, and animal life. Indeed it has been suggested that the interstimulation of these cultural-ecological regions may have been responsible for the growth of urbanism and civilization. The National Museum recognizes the unified quality of Mesoamerican culture in its Mesoamerican room, and the diversity in nine other rooms. Particularly beautiful artifacts are found in six of these rooms: the Gulf of Mexico, Oaxaca, Maya, Teotihuacán, Tula, and Aztec.

The early great ceremonial centers discovered in Mesoamerica were found in the Gulf of Mexico area. It has been suggested that they served as the capitals of the Olmec civilization. The Olmec art style is highly distinctive and is characterized by a lack of superficial adornment and the use of curved rather than straight lines. An anthropomorphized jaguar motif and the depiction of infantile human traits pervade the style. Sculptured faces (*see cover photograph*) typically have a flat infantile nose, a heavy turned-down mouth, which appears to be snarling or crying, and almost toothless baby gums from which feline fangs may emerge. The eyes are sometimes oval, sometimes oblique. Monumental heads and small heads and figurines show the range and skill of these Olmec artists, who worked in basalt and andesite, jade and serpentine.

The Zapotec and the later Mixtec cultures flourished in Oaxaca. The Zapotec center of Monte Albán was on a hill spur overlooking the valley of Oaxaca. The hilltop had been leveled to create a plaza on which stood platforms, pyramids, and temples. The *danzantes*, carved figures—perhaps of sacrificial victims—were uncovered at Monte Albán.

The lowland Maya had their centers in the Petén in Guatemala, in the tropical forests of the Mexican states of Chiapas and Tabasco, and in the Yucatan Peninsula, British Honduras, and western Honduras. The Maya ceremonial centers were essentially rectangular plazas enclosed by pyramidal mounds and platforms on which were set temples and palaces. These had superstructural roof combs and façades with carved and stucco-sculptured decoration. Arranged throughout the plazas were intricately carved stelae and altar stones. The classic Maya produced stone sculpture in the round, brilliantly colored wall paintings of religious and political events, and relief carvings in wood and stone. Their pottery is remarkable, even among Mesoamerican pottery, both for the skill with which it was made and the beauty of its colors and designs.

Central Mexico, which dominated much of the prehistory of Mesoamerica, is given several rooms in the museum, each dealing with a different major period. Teotihuacán, flourishing in the first millennium after Christ, was the first urban center in central Mexico. The main ceremonial zone at Teotihuacán is marked by two huge pyramids—the Pyramid of the Sun and the Pyramid of the Moon—a long central avenue called the Street of the Dead, and a huge structure called the del, which contains the Temple of Quetzalcóatl, a most Mesoamerican god. Mural paintings at Teotihua depict gods, humans, and animals. Ceramic and s heads are done in a simple, naturalistic style that h curiously impersonal quality.

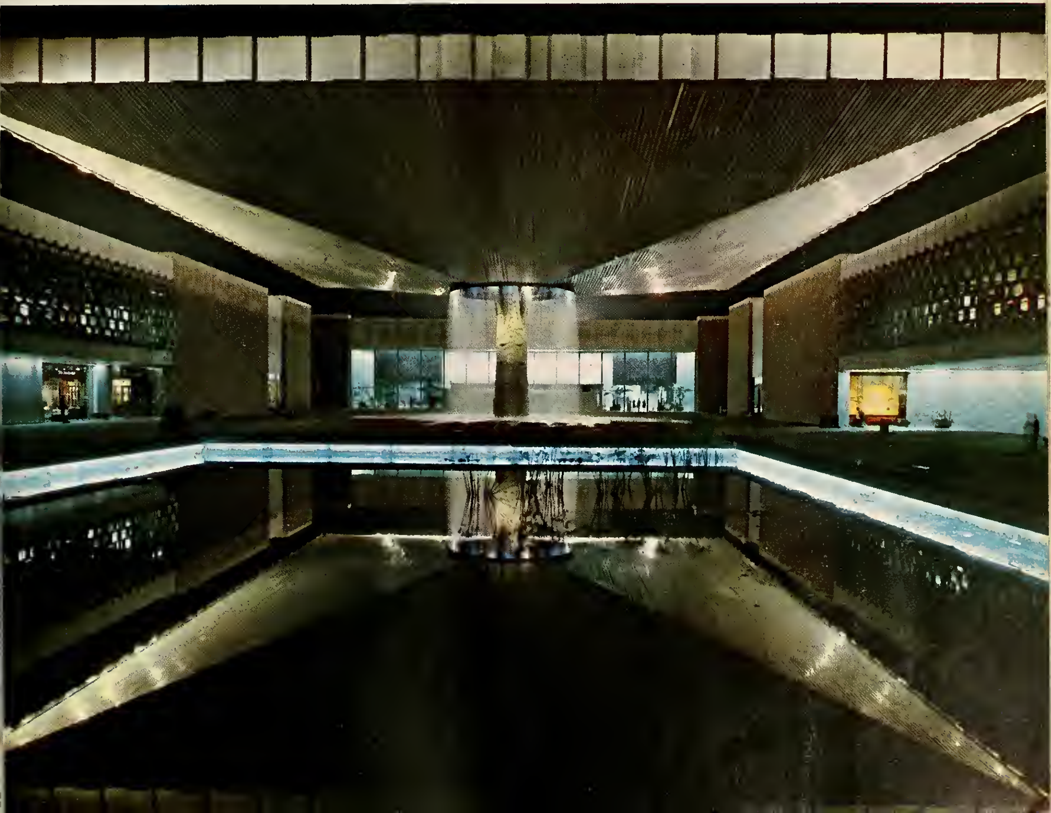
Tula, the city of the Toltecs, became the major ce after the fall of Teotihuacán. Its main ceremonial p is dominated by a colonnaded hall, part of a temple stands on a terraced platform. The carved stone colu of the temple depict warriors with their weapons. C mon decorative motifs at Tula were figures of warri skulls and crossbones, jaguars, eagles, and feath serpents. The ceramics and stonework of the To period are less interesting esthetically than those duced in other periods.

After Tula fell there was an interregnum in whic number of small city states competed for dominanc central Mexico. Ultimately the Aztecs—who establis their capital, Tenochtitlan, in A.D. 1325—won out. T ancient capital stood on the present site of Mexico C and so the immediacy of the Aztec artifacts can be not only because they are chronologically from the m recent of the prehistoric cultures and from the tim contact between the indigenous and European wor but also because many of them have been found wit only a few miles of the museum itself. Document material from the sixteenth and seventeenth centu has permitted anthropologists to give fuller account the history and life of the Aztecs than of any ot people of pre-Hispanic Mexico. Consequently, the ro devoted to Aztec archeology is quite different from others in the museum. Here the plans and models of city are supplemented by descriptions of political civic life, the motifs in the stonework are descri within the context of Aztec theology and ritual, Aztec influence throughout Mesoamerica is explained terms of wars, kings, and tribute lists.

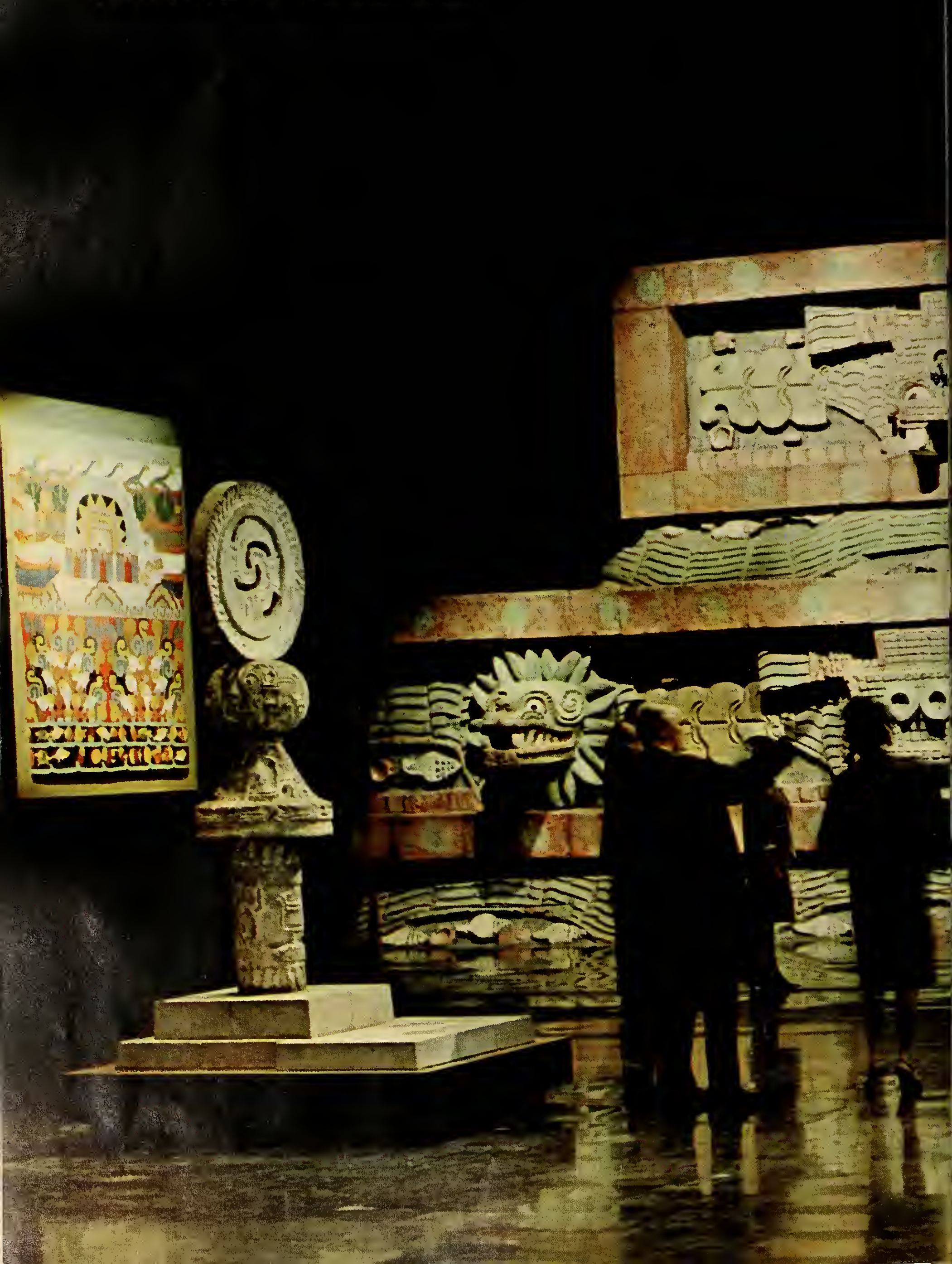
The upper story of the museum is devoted to a mod display of the culture of the contemporary indigen peoples of Mexico. Part of this culture consists of viable remains of the pre-Hispanic past. Remnants the life of the pre-Hispanic farmer are still seen in domestic ways, the economy, and the religion of Indian peasant. Some of the ancient crops, mark pottery, house forms, and rituals still persist. The pe ant wife of today in her pole and thatch house, grind corn on a stone slab, using a pottery griddle, and we ing fiber mats is in these ways not so different from pre-Hispanic ancestor. Nor is her husband, as he pla his corn and beans and carries his crops to the bustl market. The curing ceremonies retain their Indian ments, and the list of implored Christian divinities supplemented by the viable spirits of nature.

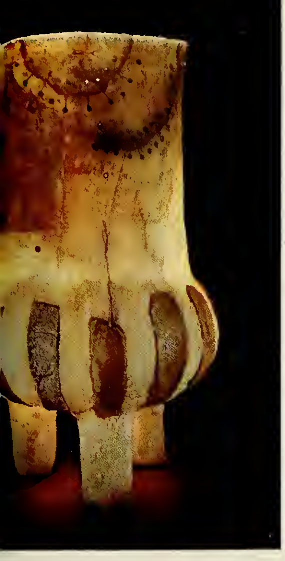
Thus contemporary Indian life is the bridge to so of the past—if not the most noble part of the past, ther least the most widespread. It was appreciation of the c temporary Indian that led to the acceptance of Mexic non-Hispanic past as a major segment of its herita The National Museum of Anthropology is a monum to this acceptance and to the pride it generates.

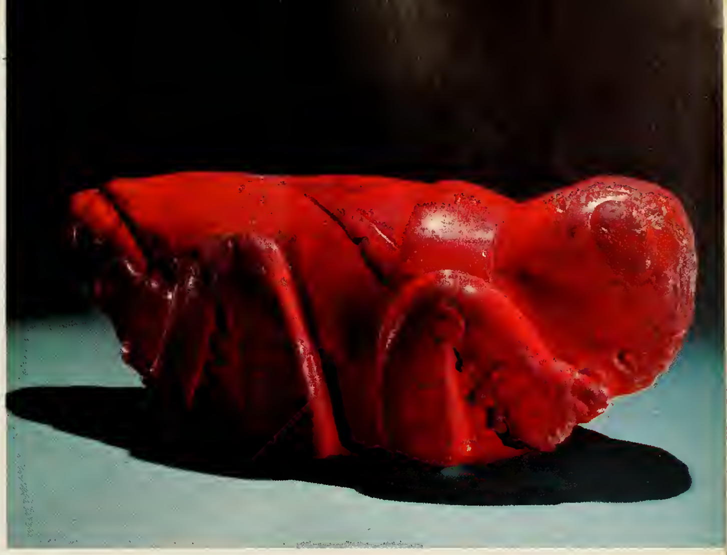
By design, the natural world forms an integral element the museum. ■ *The surrounding gardens, for example, contain pieces of sculpture, one of which, above, can be seen from the exhibition hall.* ■ *The main courtyard and its reflecting pool are dominated by a waterfall.* ■ *The central column supporting the canopy is of sculptured bronze.*

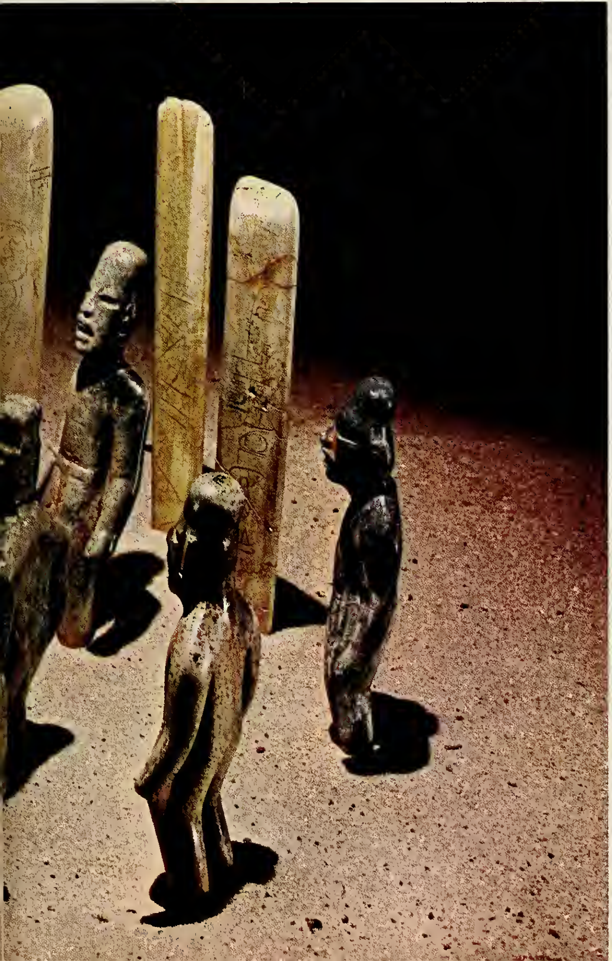


From the original in Teotihuacán,
the museum has reproduced the dramatic façade
of the Temple of Quetzalcoatl, the Plumed Serpent.

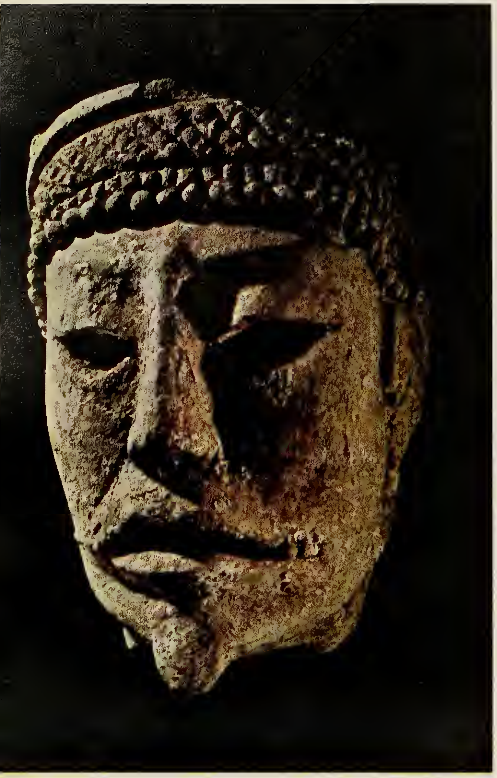


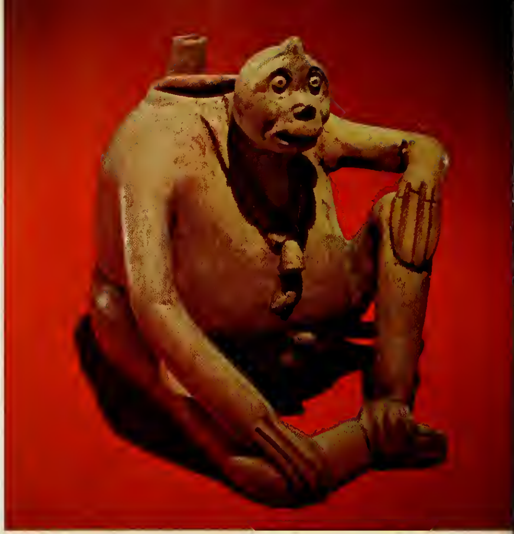




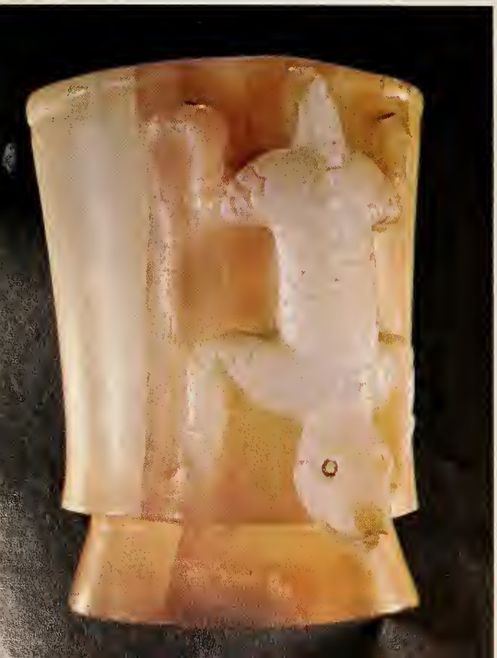


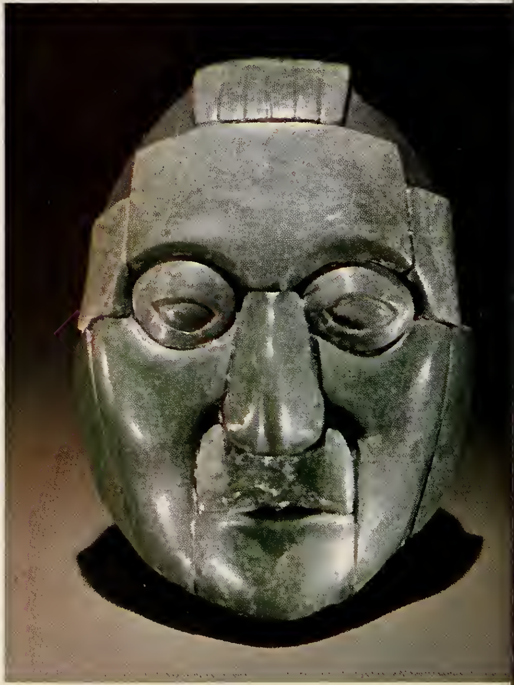
- *The figure at far left is a miniature representation, in jadeite, of a turreted temple. The piece was carved in the Mezcala River region in Guerrero.*
- *The tiny Mixtec cup next to it has a bright, sprightly hummingbird perched on its rim. The cup was taken from a tomb at Zaachila, which is in Oaxaca just south of Monte Albán.*
- *To the right of the cup, again from Guerrero, is a graceful onyx tripod vessel.*
- *The squat, but elegant, grasshopper came from Chapultepec and was fashioned from red carnelian.*
- *One of the most significant displays in the museum is the stark, impressive Olmec group at the left. It had been recovered from a ritual cache found buried at La Venta, Veracruz, in an arrangement similar to that shown here. Fifteen figurines—some in fine jade, some in serpentine—appear to be grouped together, while a single figure stands slightly apart. This figure is made of a coarser stone and stands with its back to one of the jade ax blades that form a backdrop for the group.*

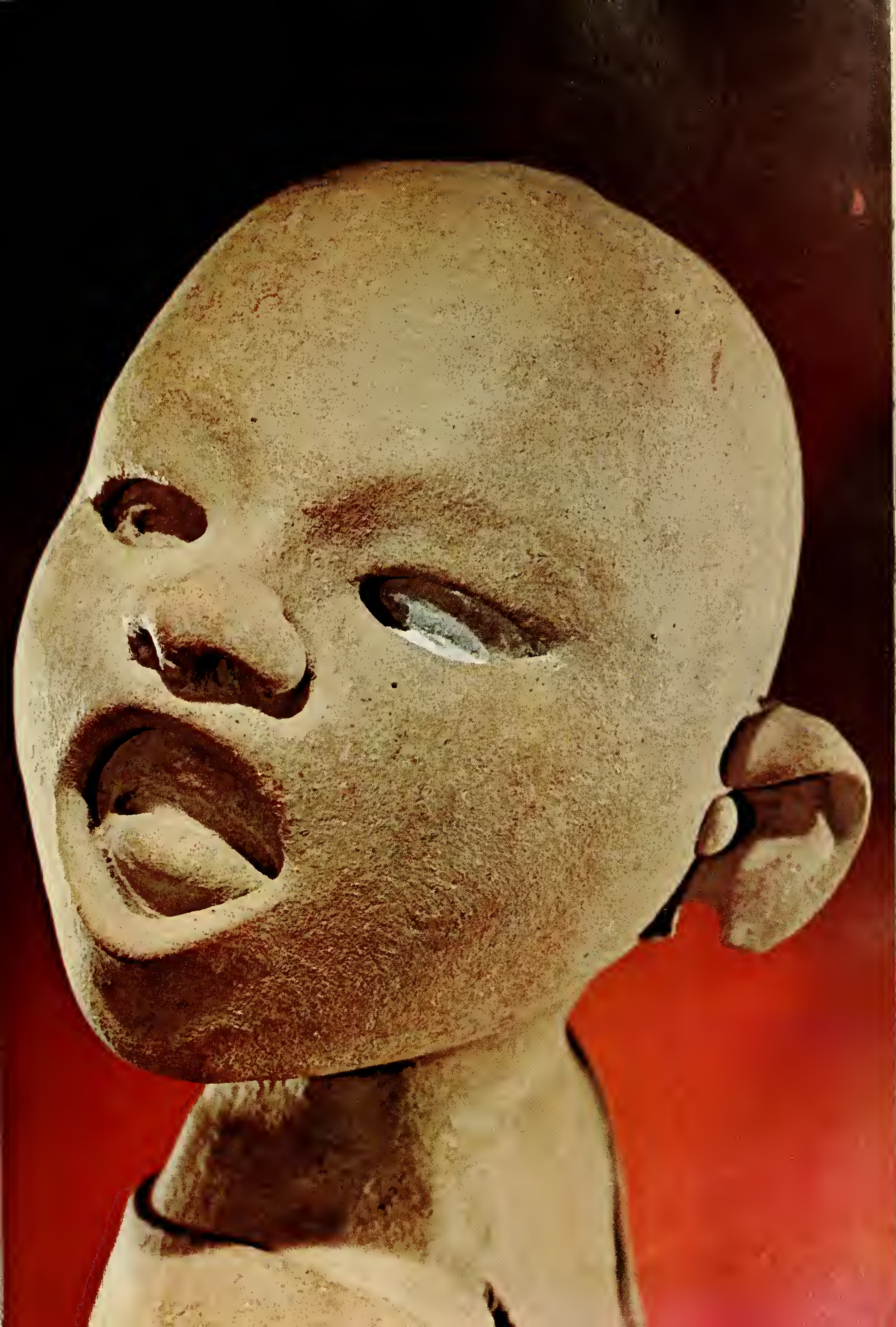




■ To the left is a large, bearded stucco head, which was cut from a wall at the Maya site of Comalcalco. ■ Clockwise from it is a terra cotta vessel, fashioned in the form of a monkey with the tail as the spout. ■ The large head is a representation of the god of spring, Xipe, whose costume is a human skin, symbolizing the new vegetation that covers the earth each year. ■ A classic Maya jade mosaic mas of an old man, below, was found in a tomb under a temple at Palenque. ■ Finally, the onyx vessel with a carved lizard handle is from Isla de Sacrificios, Veracruz.







100 Turtle Eggs

by Archie Carr

When a green turtle comes ashore she lays roughly a hundred eggs. Compared to the number of eggs layed by wholly aquatic animals, such as mackerel or lobsters, a hundred is not very many, but it is more than a lizard lays or a setting hen sets on. The eggs are big, round, and white, and they seem a great many when you see them all together.

All sea turtles lay more than once in a season. The usual green turtle comes ashore at least four times during her sojourn at the nesting beach. She often lays a few more than a hundred on her midseason trips ashore and fewer on her first and last trips. But the average is close to a hundred per nest, and there is a great deal of biology packed into that figure. The biology is still mostly unknown, but it is clearly there. The whole race and destiny of the creature are probably balanced at the edge of limbo by the delicate weight of that magic number of eggs. One marvel of the number is how great it is; but another is, how small. When you think of the unpromising future that confronts a turtle egg and the turtle hatchling that comes out of it, you wonder why sea turtles don't give up their stubborn, reckless old way of leaving their new generation on shore and instead carry one big, well-tended egg in a pouch or release myriads of turtle larvae to join the plankton, to swamp the laws of chance with teeming millions of largely expendable progeny.

The answer is that the turtles have already hit on the formula for outwitting predators or, at least, for surviving in spite of them. The formula is simply one hundred turtle eggs. For the green turtle, predation, combined with the other kinds of environmental resistance the race must meet, is measured, in a manner of speaking, as four hundred eggs per season. Any fewer, and the predation prevails and the race wanes. Any more, and the eggs are too heavy to carry in one turtle's belly, or too costly to fill with the right amount of yolk.

Perhaps I should not have started talking this way about turtle eggs, because there is no end to it, really. But I feel strongly that everybody ought to know that the size of a complement of turtle eggs is no mere accident and not simply the payload that a lady turtle is able to swim with. It is a number that is replete with ecology and evolution. So many factors are involved in setting it, in fact, that I think it may be worthwhile to try to make an inventory of them, to see how they work and how they get so interwound with each other that thinking about them makes you finally feel that almost everything the race of the turtle does, or that happens to it, is to some degree reflected in the number of eggs the female drops into the hole she digs in the sand.

A World Eager to Eat Them

Predation is the most obvious factor. If there were no predators there surely would be fewer eggs laid. So one reason the green turtle lays a hundred eggs is that most of them, or most of the hatchlings they produce, and probably even a few of the grown-up turtles are bound to be eaten by predators. A fully grown sea turtle has few important enemies. Big sharks attack them once in a while, and on shore jaguars and tigers sometimes kill them. But the main mortality is in the nest and among the hatchlings. The whole world seems against the hatchlings both during their trip from the nest to the surf and for an unknown time after they enter the sea.

If you were able to get a complete list of the animals that prey on turtle eggs and young, it would surely include most of the carnivores and omnivores, both vertebrate and invertebrate, that live near a turtle-nesting beach. The predators range in size from ants and crabs to bears and Bengal tigers. Some of them live along the beach itself, some in the coastal scrub. Some come from far back in the interior, showing up for the turtle season as the Siquirres dogs at Tortuguero used to do, and as the Rancho Nuevo coyotes do to this day. At Tortuguero nowadays the most important non-human predators are dogs and buzzards.

By chance or by adaptive arrangement, a turtle nest is safe from most natural enemies during the greater part of the sixty-day period it takes the eggs to hatch. The egg-eaters are a menace while the eggs are being laid and for a day or two afterward. After that, however, there follows a peaceful period when no animal seems able to locate turtle eggs in the nest. Why this is, nobody knows. But then comes the time of hatching and emergence, and because there is usually a strong peak in nesting intensity there is also a peak in hatching intensity: for a few weeks there may be little turtles by the thousands on the beach. For them, the danger begins when they have risen together in the nest almost to the surface of the sand. They lie there for a while as if awaiting some signal—for the thin crust over the nest to reach a certain temperature, perhaps. Whatever it is they wait for, it usually happens at night, most often after midnight, and apparently most frequently during or after light rain.

When they come out they waste no time about it. Their trip across the sand to the surf is fast as well as direct. For the turtles of each nest, this time of maximum peril in the life of the species is not really a long time at all. It is only a minute or two, or a little longer if the way to the sea should be blocked by many obstacles. Still it seems to a human observer a foolhardy violation of common sense to leave young ones far back from the sea on the hungry shore, behind dunes or debris that, chances are, cut off the way to the sea and hide it from view. The little turtles come out into a world eager to eat them. They have to go fast and straight toward the ocean even though they can't see it, never saw it before, and know of its existence only as a set of signals to react to instinctively. It

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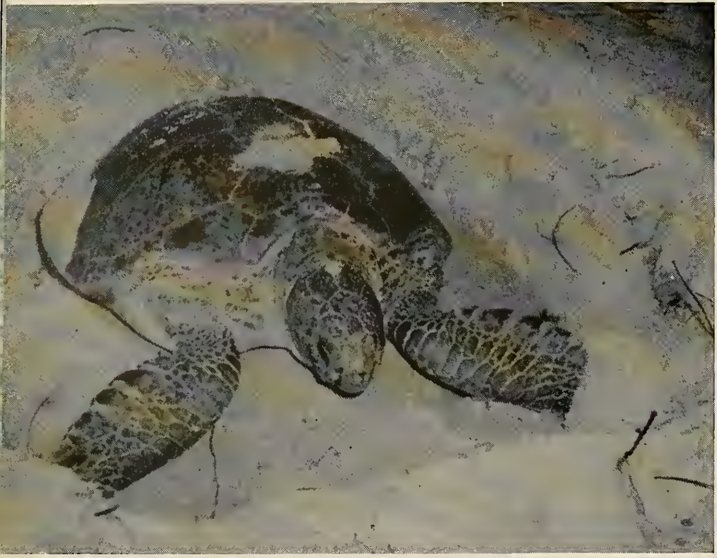


A nesting female green turtle rests in the body pit she has excavated. With her back legs, she digs the actual nest at the bottom of the body pit. Below, she has probably already laid more than eight dozen eggs.

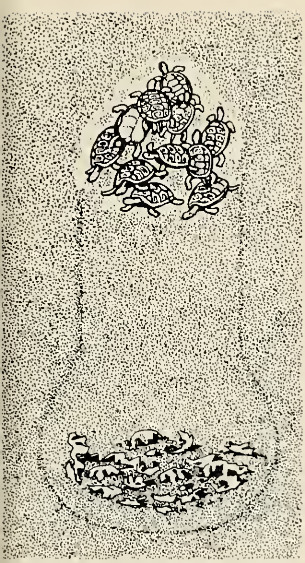
seems a little odd—the mother turtle leaving the new generation in such a predicament. Her doing it is certainly one reason she has to lay so many eggs. Serves her right, you might feel like saying: but before getting indignant you have to look at some other factors that the turtle and the race behind her, had to take into evolutionary consideration.

I have no doubt that. back in the days before turtles evolved the way they are, if somebody had suggested to their race that they ought to have fewer offspring and take better care of them—not leave them behind on land, but tend them in the sea, perhaps in the admirable way a porpoise does—the ancestral turtles would have been amenable. That this never happened doesn't necessarily mean it would have been impossible, tha natural selection could not possibly have built child-care into a turtle What it means is that except for the recent ruin humanity has brought them to, turtles are a satisfactory product of natural selection, and despite seeming flaws, they are really doing all right. They are a surviving and thus evidently successful, animal, in spite of what seems to a man the desperate plight of their young on shore. This just adds a bit more proof to the proposition that the hundred eggs a turtle lays is a packag pregnant with meaning and history In other words, ravening as the turtl predators are, they have not killed off the turtles.

But just swamping the predators overflooding the menace of enemie at the nest, on the beach, and in th sea, is not, as I have said, the onl factor that keeps turtles laying a basketful of eggs at once. There ar other, subtler ways in which man eggs laid together quite clearly ar destined to produce more new mature turtles than eggs laid singl would produce. Some of these factor are hard to demonstrate, but a colleague, Harold Hirth, and I once se out to do so and we learned enoug to be sure that the nest of a sea turtl is more than a hole full of independent embryos or hatchlings.

The Synchrony of Hatching

Until recent years most people, i they ever thought about the matte



When they are ready, the hatchlings dig and squirm their way up to the surface almost as a single unit.

at all, believed that in a turtle nest the individual hatchlings, as they emerged from the shell, dug their separate ways up to the surface, through the inches or feet of sand or soil that make the roof of the nest. People should have known better. Anybody familiar with a sea turtle beach knows that baby sea turtles come out as a sort of small eruption. For years it has been known also that various kinds of fresh-water turtles do the same thing, and that in some nests the hatchlings stay in the nests through the winter or through prolonged periods of drought and then quickly break through to the surface when they somehow feel that things are right outside—or perhaps just a period of rain or thawing makes it mechanically possible for them to break the drought-hardened or frost-hardened roof of the nest. These overwintering turtles are not separate agents that just happen to have timed their actions in the same way. They are really a kind of little team, a simple-minded, co-operative brotherhood, each member of which is to some degree better off because his siblings are there. They all contribute, to small, vital degrees, to the job of getting the group out of the group predicament of being buried in the earth. Then, after they get out they go on working mindlessly together to lower the penalties of being succulent on a hostile shore.

This is not moonshine. It is elementary, fairly sound, and decidedly fundamental natural history. You can see it happening. Larry Ogren—also a biologist—Harold Hirth, and I were able to watch the things that go on in sea turtle nests by digging up to a nest from one side and replacing the wall with a pane of glass, or by simply reburying eggs at the usual depth in a box of sand, lodging them at one end of the box against a glass pane. In a paper that Dr. Hirth and I wrote we gave this account of what we saw in nests of green turtles:

> The first young that hatch do not start digging at once but lie still until some of their nestmates are free of the egg. Each new hatchling adds to the working space, because the spherical eggs and the spaces between them make a volume greater than that of the young and the crumpled shells. The vertical displacement that will carry the turtles to the surface is the upward migration of this chamber, brought about by a witless collaboration that is really a loose sort of division of labor. Although the movements involved are only a generalized thrashing, similar to those that free the hatchling from the egg, they accomplish four different and indispensable things, depending on the position of the turtle in the mass. Turtles of the top layer scratch down the ceiling. Those around the sides undercut the walls. Those on the bottom have two roles, one mechanical and the other psychological: they trample and compact the sand that filters down from above, and they serve as a sort of nervous system for the hatchling superorganism, stirring it out of recurrent spells of lassitude. Lying passively for a time under the weight of its fellows, one of them will suddenly burst into a spasm of squirming that triggers a new pandemic of work in the mass. Thus, by fits and starts, the ceiling falls, the floor rises, and the roomful of collaborating hatchlings is carried toward the surface.

So there is no parental care and no teaching or guarding by any mature turtle. The little survival team is not trained or prompted by any coach, nor does it consciously work toward any common end. It is just a lot of baby turtles getting restless and becoming annoyed with one another, but in useful ways. Their petulance at being crowded, jostled, and trod upon makes them flail about aimlessly. It is the aimless flailing that takes them steadily up to the surface.

To demonstrate the real utility of this involuntary teamwork (or "proto-cooperation," as such relationships were named by Dr. Clyde Allee back in the twenties) you only have to bury single eggs at nest depth and then keep track of their fate. Their fate is dismal. In our tests, out of twenty-two eggs that hatched singly, only six of the hatchlings reached the surface of the sand. All these were too weak to continue across the sand to the water. As more eggs are added to the experimental groups, arrivals at the surface increase, although maximum success was achieved by clutches of eggs far smaller than the average one-hundred-egg clutch laid by sea turtles. We found, in fact, no increase in emergence-success in groups greater than ten. A ten-turtle team seems just as able to reach the surface as a group of one hundred.

The Rewards of Being Many

There are other social advantages in the big groups, however. These have not yet been investigated carefully, but there seems no doubt that the unconscious co-operation continues during the trip from the nest to the surf. Once the hatchlings are out on the beach the bonds that integrate the band of nestmates loosen, and each hatchling is more completely dependent on his own senses to take him across the sand in the right way to find the sea. Even here, however, the hatchling that is one of a hatful of nestmates seems to have a slight advantage over one that comes out alone. In tests with young hawksbills, hatchlings that were allowed to crawl singly across the beach stopped more often than siblings released in groups, and seemed to lie still longer during stops and perhaps to orient less surely toward the surf line during bursts of travel. Single turtles, thus, are on the open beach longer and are more likely to be caught by a ghost crab or, if emergence has been by day, to dry up. When a nestful of hatchlings comes out all at once or in a few smaller contingents, periods of hesitations are fewer and shorter simply because the turtles keep bumping into one another. If a sprinkling of hatchlings has stalled for a time, and a nestmate comes charging up from behind and touches one of them, the one touched springs into action, the action spreads, and the whole group scrambles away toward the sea as if you had wound them up like toys and set them down together. Here the advantage of being one of a group is simply that each member may remain less long sunk in recurrent spells of lassitude. There is also some evidence that the path of members of a big group of hatchlings trends usually more directly toward the sea than that of turtles traveling separately. The main body of the group is nearly always well oriented. When a single hatchling strays in a way that takes him across the stream of traffic, he usually corrects his heading to conform with the group course.

These observations have been casual and are not supported by data. They came back to mind clearly, however, when William Hamilton, of the University of California, told me of finding that migratory groups of birds are able to guide themselves better than birds migrating singly.

Such advantages are almost surely part of the reason that a green turtle lays a lot of eggs instead of only one. There are no doubt many more reasons, even less easy to see at work or to prove by statistics. There is some indication, for instance, that eggs heat up slightly from their own vital functioning. Another zoologist, John Hendrickson, found the temperature to be higher in turtle nests than outside, and so did Harry Hirth at Ascension Island. By simple rules that apply to volumes and surfaces, a big bunch of eggs should warm itself more than a single egg does, and being a little warmer may be some help in incubation.

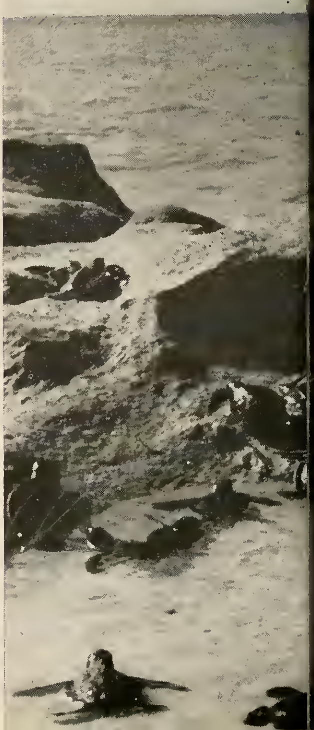
After the hatchlings enter the sea they may regroup somewhere and somehow gain more advantage from being a group again. Nothing can be said about this because nothing is known about baby turtles once they have entered the sea.

So far I have talked a good deal about possible reasons why sea turtles lay so many eggs, but have said nothing about why they don't lay more. The lowness of the number one hundred has to be explained, too, because there are definite advantages in producing a great many offspring. I doubt that it is just an accident. A number of factors are probably at work to keep the number from rising. One way to increase the number of eggs would be to make them smaller. To do this the amount of food for the embryo would have to be reduced. This would be bound to cut down the size of the hatchling and thus to turn it out into the world less well equipped to scramble, to resist drying up, and then to do whatever is required of little turtles to get through their first hidden year in the ocean.

An increase in the number of eggs with no accompanying decrease in their size would almost surely overburden the female. The female green turtle may have to swim a thousand miles to her nesting ground, and once there, to fast throughout the period of time it takes her to complete the assembling of, say, four successive sets of shelled eggs for the four nestings of her season at the breeding ground. Here again, nothing at all is known about the amounts of energy involved, but it would obviously be pretty unreasonable to suggest that a sea turtle should haul more eggs around.

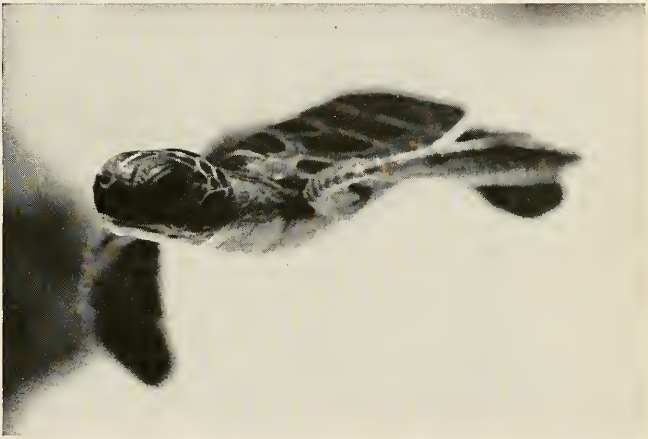
Even if the female turtle could carry more eggs to the beach, she would probably have trouble housing the bigger clutch in a proper nest. A proper nest is one with the right conditions of temperature and humidity, as well as one with a roof thick enough to hide the eggs. The nest a sea turtle digs is not just a pit. It is an elegantly flask-shaped, slightly lopsided chamber: the spherical section communicates with the surface by a narrow neck. From the care with which the turtle adheres to the standard pattern in making this cavity, and from observations of hatchlings emerging both from such bottle-shaped natural nests and from artificial nests of straight-sided cylindrical shape, there seems to be some advantage in the flasklike conformation. In the natural nest the emergence-group appears to be a little less troubled by heavy cave-ins that cover them in loose sand, slow down emergence, and break the group into smaller units that come out at different times or not at all.

One important function of the nest is to provide the eggs and young with a way to avoid desiccation, flooding and temperature fluctuations. The nest must be deep enough to damp down the daily changes in weather and to keep the eggs in continuously moist, continuously warm sand, and yet not so deep that high tides in the sea flood it and drown the embryos in salt water. All these considerations would seem by logic to be involved in determining the size of the nest and logic also suggests that the size of the nest to some extent influences the volume of eggs that the race produces. And yet if you watch a sea turtle make her nest you might conclude that the only factor influencing the size and shape of the nest is the digging reach of the turtle that makes it. Every female sea turtle makes her nest just as deep as her back leg is

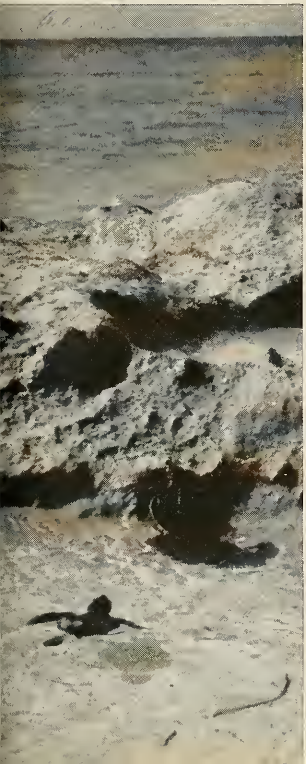


able to reach. There are two ways, therefore, that she is able to control the microclimate of the nest. One is to choose the right beach, and the right place on it; the other is to vary the depth of the body pit, the broad shallow basin that some sea turtles make to rest in while nesting. The nest proper is dug in the bottom of the body pit, and the depths of the body pits that green turtles make vary markedly. This gives the turtle the necessary leeway in locating the nest at the most appropriate level, despite her stereotyped insistence on digging the nest down as far as she can possibly stretch her back leg. How sea turtles divine proper beaches and nest sites is not known. That they do divine them seems obvious from the small number of badly placed nests one finds, and indeed, from the very existence of sea turtles.

To be continued in the next issue.



Young turtles, below, scuttle to open water. Once the hatchlings have found their way to the sea, they embark upon a journey whose course is a mystery. No one knows where the turtles go.



SKY REPORTER

Data from two interplanetary spacecraft indicate that the earth leaves a 3.5-million-mile-long wake in the solar wind.

The solar wind consists of charged particles streaming out from the sun at about a million miles an hour. The earth and its living organisms are protected from most of these high-energy particles by the earth's magnetic field, which causes the solar wind to divide and flow around the earth.

The wind divides about 40,000 miles out on the sunward side of the earth. It streams past the earth outside a magnetic cavity that is about 160,000 miles in diameter. Then, at a point far "downwind" from the earth, the flow of particles reunites and continues on its way.

The Pioneer VI and VII spacecraft found the tip of this wake left by the earth's "magnetosphere" in the solar wind. This point is about 3.5 million miles downwind from the earth.

RU CAMELOPARDALIS

Since it was first noticed in 1907, the star RU Camelopardalis (familiarly known as RU Cam) has steadily varied about 1.5 magnitudes in a 22-day period. It appeared last year, however, that RU Cam, a circumpolar variable, had stopped its familiar pulsating.

A check of plates at the Sonneberg Observatory in East Germany revealed that between 1962 and 1965 the star had pulsated less and less. By 1966, it was varying by only 0.08 magnitudes.

If the star truly stopped pulsating in a mere four years, it would be remarkable. For even if the cause of pulsation were somehow suddenly turned off, it should take at least a thousand years for a star—like a pendulum—actually to stop pulsating.

The cause may be, then, that variations in both the minimums and maximums of the star's variable brightness curve approached each other so that they almost met. If this is true, then the amount of variation can be expected to start increasing again in a year or two. Thus there is a close watch.

RU Cam is a Cepheid variable (*see* NATURAL HISTORY, October, 1966). It lies in the coma of our Galaxy, the nearly spherical arrangement of clusters and individual stars around the main disk.

DUST CLOUD MOONS

It appears more and more certain that two clouds of dust are circling the earth ahead of and behind the moon.

Writing in *Physics Today*, J. Wesley Simpson reports photographing the two clouds last year from a jet flying at 40,000 feet (above 85 per cent of the atmosphere).

As the earth and moon revolve around their common center of mass, there are five points of equilibrium at which a particle could have a stable orbit in the earth—moon system. Three of these are along the line connecting the centers of the earth and moon. The other two are 60 degrees ahead of and 60 degrees behind the moo
as it circles the earth.

For hundreds of years, astronomers have predicte
that captured bodies might be present at these last tw
points. The dust clouds were observed by Kazimier
Kordylewski in Poland in 1956 and first announced i
1961. Simpson and his colleagues made the first Wester
Hemisphere sightings in 1964.

The clouds range in magnitude from 5.5 to 6.5 an
under perfect conditions should be visible to the nake
eye. Their size varies from one to four degrees. The
are impossible to see when in or near the Milky Wa
or any bright object.

It is not clear just what the dust clouds are compose
of. But as Simpson says, they may be "reservoirs o
interesting cosmic rubble" and could provide information about our local cosmic history.

John P. Wiley, Jr

CELESTIAL EVENTS

In early August Mars is in Virgo, left of Spica; the
it moves through Libra and, during September, int
Scorpius. By late September, the reddish planet will b
near the star Antares, which it will resemble in magnitude (0.9) and color. Mars is to the right until September 23, to the left thereafter. On September 9, the nearly
first-quarter moon will be between Mars and Antares
closer to Mars.

Venus is low in the west at sunset in early August
and a morning star in the east in September.

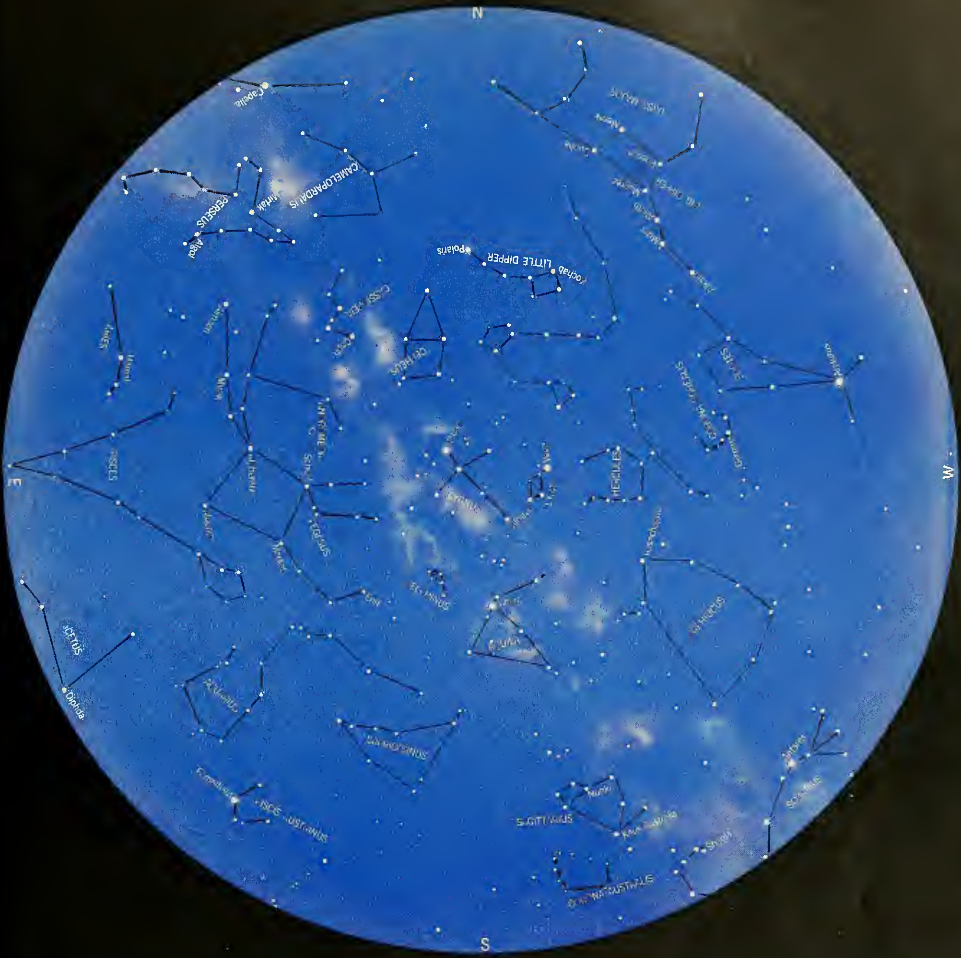
Saturn, these two months, is in the sky most of the
night, from dusk (when it rises in the east), till daw
(when it sets in the west). Now at magnitude 0.6, the
planet is in Pisces, south of the western stars of the
Square of Pegasus; it is brighter than any nearby star
Mercury is not now in a favorable position for viewing

The autumnal equinox, when the sun, moving south
arrives over the earth's Equator, occurs at 12:38 P.M.
EST, on September 23.

The annual Perseid shower reaches maximum on the
night of August 12/13, but may be seen for severa
nights before and after. There is no moon to interfer
with early morning observations.

Thomas D. Nicholso

Hold the star map so the compass direction you face i
at the bottom; then match the lower stars with those i
the sky. The celestial events chart shows times of risin
and setting of the sun, moon, and principal planets; time
of twilight; and sundial correction during August an
September. Horizontal scale shows time. The top stri
locates bright stars, planets, and the moon within the zodia
for August; the bottom strip shows these for Septembe
The vertical scale shows dates; the upper half for Augus
and the lower half for September. The horizontal scal
of hours shows time when planets and certain stars ar
due south and highest at midmonth. The phases of th
moon shown are due south and highest on dates indicated


N
Capella
PERSEUS
Algol
Mirfak
CAMELOPARDALIS
URSA MAJOR
Polaris
LITTLE DIPPER
Kochab
CASSIOPEIA
CEPHEUS
E
PISCES
CETUS
Diphda
HERCULES
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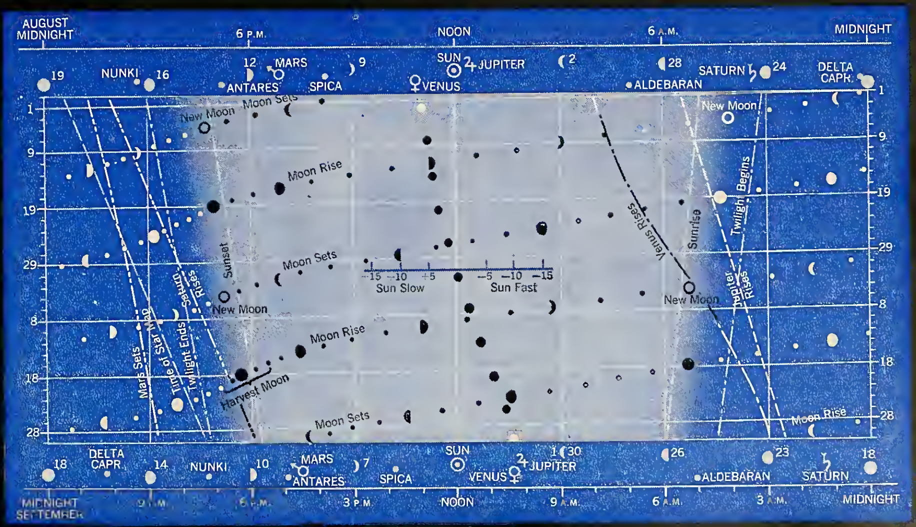
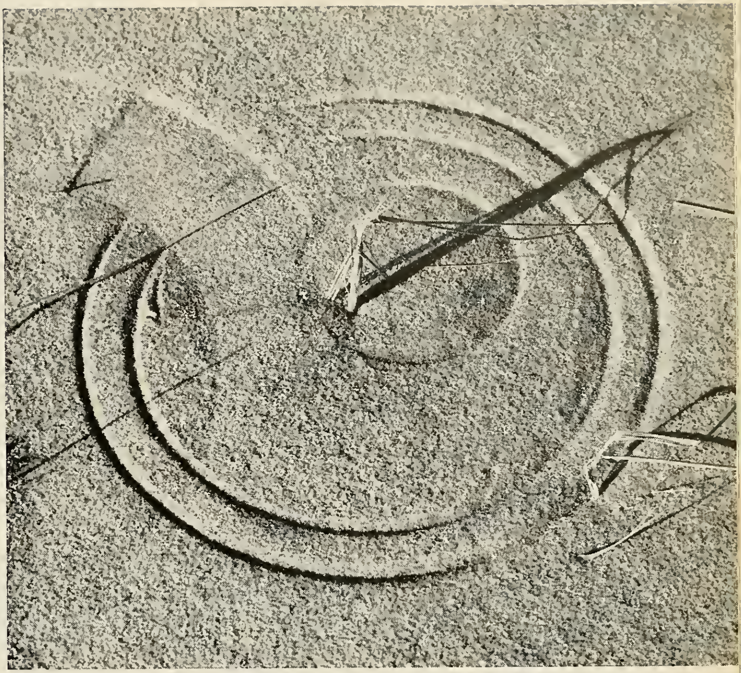
Kaus Australis
Fomalhaut
PISCES AUSTRINUS
SCORPIUS
Antares
CORONA AUSTRALIS
S


AUGUST MIDNIGHT
6 P.M.
NOON
6 A.M.
MIDNIGHT
19
NUNKI
16
12
MARS
ANTARES
SPICA
9
SUN
JUPITER
VENUS
2
28
SATURN
24
ALDEBARAN
DELTA CAPR.
1
9
19
29
8
18
28
New Moon
Moon Sets
Moon Rise
Moon Sets
New Moon
Moon Rise
Harvest Moon
Moon Sets
Sunset
Saturn Rises
Twilight Ends
Time of Star Map
Mars Sets
-15 -10 -5
-5 -10 -15
Sun Slow
Sun Fast
Venus Rises
Sunrise
New Moon
Twilight Begins
Jupiter Rises
New Moon
Moon Rise
18
DELTA CAPR.
14
NUNKI
10
MARS
ANTARES
7
SPICA
SUN
VENUS
1
30
JUPITER
26
ALDEBARAN
23
SATURN
18
MIDNIGHT SEPTEMBER
9 P.M.
6 P.M.
3 P.M.
NOON
9 A.M.
6 A.M.
3 A.M.
MIDNIGHT

mast of a sunken ship rises like a cross above the vater. Creeping sands ıtually bury most of the wrecks claimed by the island.

Buffeting, changing winds and a stylus of stiff dune grass conspire to draw a dial in the soft sands of Sable Island.



arsh winds,
an odd fauna,
nd a stormy history
mark curious

sable island

by Fred Bruemmer

Sable Island is a sandy crescent of land far out in the Atlantic, 150 miles east of Halifax, Nova Scotia. oughly 30 miles long and barely 2 miles wide, it is the posed part of a 100-mile-long sand shoal, which retches northeast to southwest. More than 400 ships ve come to grief on the island's low, shifting shores nce its discovery by the Portuguese in 1500, earning it reputation as the "graveyard of the Atlantic."

The Portuguese visited the treeless, windswept island veral times in the years following its discovery and en mapped the island in 1505. They also released ttle on it in a fruitless effort to convert some of the land's sparse vegetation into protein.

In 1598 fifty French settlers bound for Canada were posited on Sable Island, while their commander, e Marquis de la Roche, continued to the mainland scout out a suitable settlement site. The island was ready feared and famous as a wrecker of ships.

A storm drove the Marquis back to France, and when ship finally returned five years later to retrieve the settlers from Sable, only eleven were left. They had survived by killing the feral cattle (remnants of the Portuguese experiment), the seals, and the walruses, then still numerous on the island.

During the next century, ships from Boston visited the island fairly frequently, to rescue survivors of shipwrecks, to loot wrecks, and to kill cattle and walruses. By about 1720, all the animals on the island except the seals and some elusive foxes had been exterminated.

In 1738, Andrew LeMercier, pastor of the Huguenot church in Boston, decided to establish a settlement of French Protestants on Sable Island. As a start, he sent a shipload of livestock to the island. But the pastor could not or would not raise the penny-an-acre quitrent for Sable, and in 1753 he gave up the whole idea, probably to the relief of his parishioners. "When I took Possession of the Island," wrote LeMercier, "there was no four-footed Creature upon it but a few foxes, some red and some black. Now [1753] there are I suppose, 90 Sheep, between 20 and 30 Horses including Colts,

Of New England origin, the island's wild horses are short, stocky, and quite hardy. They live and forage in herds, each with its own small territory.

Stallions and Breeding Mares, about 30 or 40 Co
tame and wild, and 40 Hogs."

Near Sable Island the cold waters of the Labra
Current meet and mix with the warm waters of
Gulf Stream. Both currents are strong and both te
to deflect ships toward the island. The average wi
speed on Sable is slightly more than 20 miles per h
during the year, and the low island (its greatest du
rise to less than 100 feet) is often fog-shrouded:
nine solid weeks one recent summer. All this ma
Sable a serious threat to navigation. During
eighteenth century as many as fifteen ships were
upon its treacherous shores in a single year.

To increase the odds of disaster, piratical wreck
established themselves on the island and lit false b
cons to beckon even more ships to their doom. T
also killed the descendants of the pastor's livesto
only a few horses survived. Complaints piled up
the British Admiralty. In 1800 the wreckers w
chased off the island; in 1801 the government of N
Scotia established a lifesaving station on Sable Isla

One more attempt was made to bring livestock to
island. The men from the lifesaving station brou
pigs and released them. The animals prospered
some years, but in 1814 they were all shot, when it
discovered that they had turned into ghouls, digg
up bodies of drowned sailors from the sand and
ing them. Since then, the pastor's horses and the na
seals have had the island to themselves.

The horses live in small herds, each led by one of
strongest island stallions, with three or four mares
a couple of colts. There are also several herds cons
ing only of stallions, the young, the old, and the we

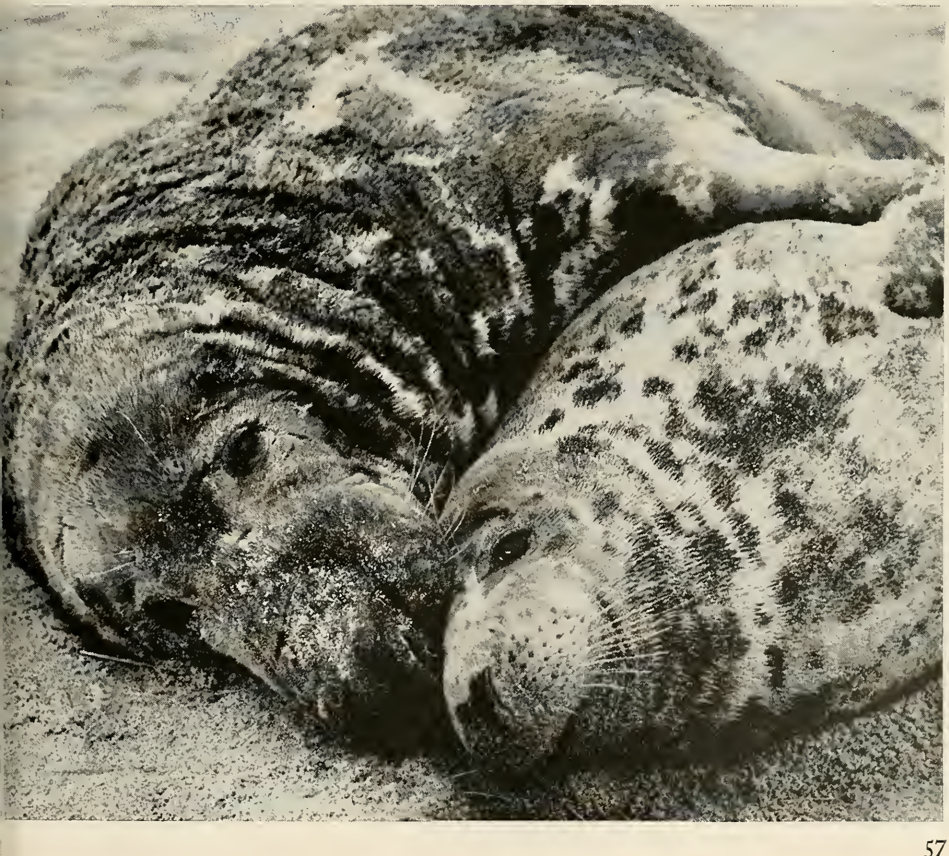
The number of horses has varied greatly during
years. A hard winter, with plenty of snow, can
most of the herds. There are more stallions than ma
on the island, and the mares foal, on the average, c
every three to four years, so that the population
creases slowly after each disastrous winter.

In 1828 there were about 300 horses on Sable,
in 1864, and 250 in 1895. In 1952 they had increa
to 320, but then a series of bad winters decimated
herds. In the 1964/65 winter, more than 100 ho
died, and in January, 1967, we counted only 181 ho
on Sable Island.

Each herd has its own, small territory and ra
roams farther than a mile or two, a habit simila
that of the Dartmoor ponies in the southwest of E
land. During the late nineteenth century, horses f
the mainland were on several occasions brought to S
"to improve the island breed." Their influence is q
noticeable, but nevertheless a typical Sable Island
is easily recognized: small (about 12-14 hands hig
stocky, and short-eared, with heavy, dark brown
and long black forelock, mane, and tail. Most ho
have a dark dorsal stripe.

Except for two herds living in the vicinity c
meteorological station, the horses are very shy. W
a man comes to within about 100 yards of a herd,
lead stallion whinnies warningly and a moment l

Since they share their home only with some horses and sparrows, Sable's seals have ample space either to thump inland, leaving tracks in the soft sand, or to scatter luxuriously along the shore. Mostly monogamous, a male seal, below, clasps his female with both his flippers and his teeth.



the horses gallop away, their hoofs thudding on Sable's sand. The horses are fully protected now. A law passed by the Canadian government in 1961 states that "No person shall molest, interfere with, feed or otherwise have anything to do with the ponies on the Island."

Wind and waves continually erode Sable's dunes; over the centuries the entire island has moved many miles from west to east, and has also, apparently, decreased in size. Government efforts at forestation have been unsuccessful. Of 80,000 trees planted in 1901, a single one remained a quarter-century later. But cranberries grow on the island, as well as marram grass, yarrow, creeping roses, goldenrod, and stunted, wind-flattened juniper bushes.

Under the protection of this low mantle of vegetation, a small, inconspicuous bird builds its nest in Sable's dunes. It is the Ipswich Sparrow, named after Ipswich, Massachusetts, where one was killed and first identified by C. J. Maynard in 1868. In winter this sand-colored sparrow is seen along America's Atlantic coast as far south as Georgia, but in summer all Ipswich Sparrows return to Sable Island, the only place where they are known to breed.

In winter the beaches of Sable are home to one of the largest breeding colonies of gray seals (*Halichoerus grypus*) in North America. Most of the estimated 5,000 gray seals on this continent breed on small isolated islands off Canada's east coast: Amet Island in Northumberland Strait, Basque Island, off Cape Breton, Deadman Island in the Gulf of St. Lawrence, and on the ice in George Bay, west of Cape Breton Island. A small gray seal colony was discovered some years ago on Nantucket Island.

Most of these islands are small and space is at a premium. A powerful bull, weighing up to 1,000 poun
will stake out a portion of territory and defend it, a
females on it, against all rivals.

On Sable Island, however, there is plenty of spa
The seals scatter over a wide beach area, and most
them are monogamous. Bachelor bulls and immatu
gray seals crowd together in groups of about 150
200, each at extreme ends of the island's east a
west spits, far from the breeding colonies.

The first seals come ashore to calve on Sable Isla
toward the end of December, and most pups are bo
between the 10th and the 25th of January. The pu
their furry white natal coats usually stained yellow
by amniotic fluid, weigh about 30 pounds at bi
They thrive on their mothers' fat-rich milk (52 per c
butterfat) and balloon out to nearly 100 pounds
two to three weeks.

Because gray seals are vectors of codworm, a pa
site that does considerable damage to the fishing
dustry, the number of gray seals in Canada and
Britain, where they are considerably more numero
is now controlled by periodic culling. In 1967, 150
the 200 gray seal pups on Basque Island were kill
Sable is too remote and inaccessible, however, and h
seals are increasing slowly, so that the total number
gray seals on the island at the end of January was
timated at 1,500.

But Sable Island, lonely and remote, gravey
of ships and cradle of seals, may soon be yanked
of its isolation. Geologists think there may be oil
posits below its shifting sands, and large-scale drill
operations are planned both on the island and in
vicinity. The discovery of oil would probably be
final blow to Sable Island's strange fauna.

The debris of ill-fated voyages regularly washes ashore on Sable Island. A furry gray seal pup lies by a half-buried pickle barrel.

With no one home to sweep, an aband
house is invaded by a glacier of sa
The island's rain, snow, and sand storm
constantly tax the works of

ARCHAEOLOGICAL CHRISTMAS CARDS

For the first time, the Archaeological Institute of America is offering a selection of cards featuring ancient monuments and works of art.

Each set of 20 includes 4 each of 5 different subjects, printed in full color on fine coated stock. Each subject is identified and dated; each card is inscribed *Holiday Greetings.*

A mosaic of Magi in red, green and gold; a blue Persian dome; a Greek temple among pink oleanders; a Byzantine church lost among mountains and the Lyre Player from the Palace of Nestor at Pylos carry your holiday message. In addition, 20 notes without greetings, showing two lively Panamanian gold figures, are also available.

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The sun and double star

by James S. Pickering

The sun is a star that requires totally different methods of observation than we have learned before. The sun is relatively near to us and is thus the only star whose surface we can see. Its mean distance of 93 million miles represents a light-travel time of slightly more than eight minutes. The light time from the second nearest star to the earth is four and one-third light-years, which, compared with eight minutes, will give an idea of the relative distances.

The sun is dangerous. Its surface temperature of about 10,000 degrees Fahrenheit is the residue of a core temperature of about 35 million degrees. And even though it is 93 million miles away, it is still so bright that we cannot look at it without hurting our eyes. Anyone who has amused himself by using a magnifying glass for focusing the sun's rays to make paper burn knows the sun's intensity. A telescope is a tremendously powerful magnifying glass. Just as no one would put his eye at the focus of the reading glass after watching the paper burn, no one should ever, under any circumstances, attempt to observe the sun directly through a telescope, field glass, or any sort of optical instrument. The fierce, concentrated energy of the sun would seriously damage or destroy your eye in a fraction of a second.

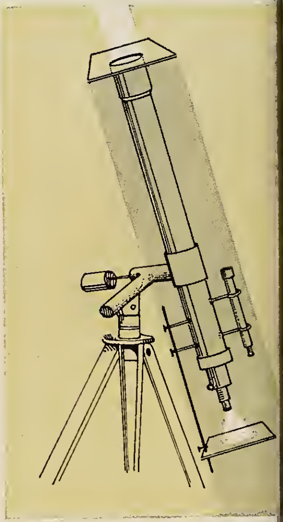
There are filters that may be used safely, but here, too, I urge extreme caution. Some eyepieces have safe filtering devices that are ventilated to permit the escape of the intense, concentrated heat as well as the light. Since the habitual use of the finder is dangerous, be sure to keep it capped if you observe the sun by any means. It is also good practice to reduce the telescope aperture to about half of its normal opening by making a cap for it. This was described in the article dealing with observation of the moon (NATURAL HISTORY, January, 1967).

In general, it is safest not to observe the sun directly in any way. Although you will hear and read of various devices and methods that make solar observation safe, human error is always present. Incorrect adjustments, forgetfulness, or accident can produce tragic results. Some observers advocate the use of welder's glass placed over the objective, but even welder's glass been known to split unexpectedly, the damage can be done before observer can snap his eye away the ocular.

The Sun by Projection

The safest way to observe the su by projection. Many telescope ma provide a solar screen, usually a painted metal plate that can be e attached to the telescope tube so it is held beyond the eyepiece l light wire frame. Then when the scope is pointed at the sun, the s image is projected through the scope onto this plate and can be s examined. Or a piece of white c board, preferably with a dull, mat ish, may be held in position by h This is also the most sociable wa observing since not only the teles operator but his friends and neigh as well may look at the same time.

The farther the card or plate is f the eyepiece, the larger the proje



To project the sun for safe and con able viewing, place one piece of cardb just beyond the eyepiece to receive image and fit another piece over outer end of the tube to shade the jection screen and thus clarify the in

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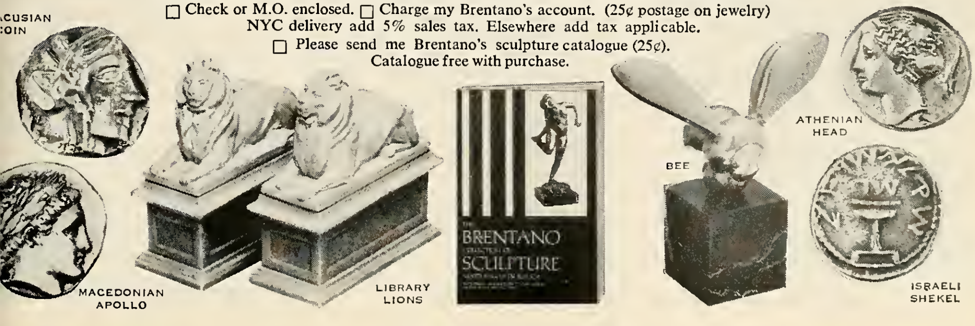

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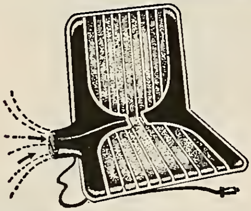

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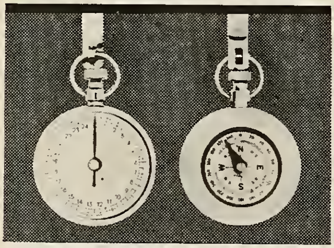

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image will be. This image should. of course, be focused in the conventional manner for the clearest definition possible. For a further refinement in solar observation fasten a large piece of cardboard to the outer end of the telescope tube so that the objective projects through a hole in the center. This will shade the screen and increase the clarity and contrast of the image.

The intense heat of the concentrated sun could damage the lenses as well as the mirrors if you have a reflector. So it is advisable to allow the telescope to cool off now and then during a session of observing by swinging the tube away from the sun. If you are called away from the telescope. do not forget to take this precaution.

Since you cannot use the finder in these observations, locate the sun by watching the shadow of the telescope on the ground. Then move the telescope until the shadow is obviously that of the end of the tube. The bright image of the sun should then be projected on your screen, and slight final adjustments will bring out the details.

The sun's most obvious and prominent features are sunspots. These appear as irregularly shaped dark areas, sometimes singly, sometimes in closely associated groups. The dark, central area is the umbra and the lighter surrounding region is the penumbra. There may be, at times, several closely associated umbras surrounded by one, all-embracing penumbra.

A record of sunspot sizes, shapes, positions, and times of appearance and disintegration can be interesting and easy to keep. Prepare for it by drawing circles on separate pieces of mat-finished cardboard—circles about four to six inches in diameter. Focus the image of the sun so that it just fills the circle; then, in pencil, draw around the spots as they appear. This is physically easy to do with a refractor. I have sat on a stool in my own backyard with the tube of the telescope over my shoulder and my back to the sun, projecting the sun on a circle on the cardboard held on my knees. The same operation using a reflector presents problems because of the eyepiece, but if you have a solar screen on the tube, it is not so difficult.

If continued, such a record will show the progress of the spot as it is carried across the face of the sun, not by any motion of its own, but by the rotation of the sun itself. Sunspots do

---

James S. Pickering, Astronomer Emeritus and a lecturer at the American Museum-Hayden Planetarium, is the author of "Windows to Space," published by Little, Brown and Co.

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move around on the sun. They stay ere they originally appeared, but as sun rotates they are moved across visible disk of the sun. The sun ates in the same way that the earth ates, counterclockwise as seen from ove the sun, or from left to right as see the sun. In fact, man received first hint about the sun's rotation m the apparent travel of sunspots oss the sun.

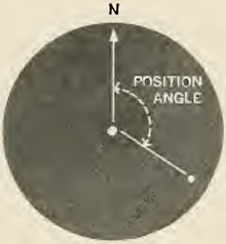
The sun is now emerging from a ıspot minimum that covered parts the years 1964 and 1965. During s period, known as the International iet Sun Year (IQSY), there were es when no spots could be seen, and re were generally very few and very all spots for much of this period. w, however, the early spots of the v cycle are coming into view and l build up to a new maximum in 9. The first spots of a new cycle ap- r in the high solar latitudes, far ve and below the sun's equator. is cycle can be recorded with a regu- solar observation program.

Double Stars

Iost of the stars appear to be soli- when observed by the eye alone. ually, about 60 per cent of the stars the small segment of the universe ilable to us by all observational hods are double or multiple. There optical doubles, in which two stars, ıough not physically associated, are aligned that they appear double, n though one may be light-years ond the other. There are also true s of stars, those that revolve about nter of gravity common to both and are relatively near each other. se are binaries, many of which are emote and so closely associated that naked eye can perceive only one ıt of light from the pair. Others, more distant, can only be distin- hed as binaries because of the bling of their absorption lines n their light is passed through a troscope.

Iany doubles can be identified as ı by backyard telescopes. This vhere Dawes's Limit is applied. ves's Limit says that a telescope can ırate the components of a double to get the angular, or apparent, ıration by dividing 4.56 by the ture of the objective. A 6-inch re- or, then, should be able to split a with an angular separation of seconds of arc. This is close and ıld not be hoped for under normal litions with the usual backyard scope. In reality, if you can break pair whose separation is less than conds of arc, you are doing well.

lists of double stars, there are lly three items given. First is the ration, or distance, which is the ılar distance between the two components. This is usually expressed in seconds of arc even if the total is more than one minute of arc. For example, the separation of Alpha Capricorni, a visual double, is given as 376″, although it could be translated into 6′ 16″. The second factor is the position angle, usually abbreviated as P.A.



The position angle of a double star is formed at the brighter star by the line toward the fainter star and the line toward the North Pole. It is measured up to 360° from north past east and so on.

This is the angle between the north point of the field of view of your telescope and the fainter of the two stars. The apex of this angle is the brighter star. It is always measured eastward from the north point. Finally, the date when the two components were at the listed position is also recorded, since the stars are moving and this angle will change.

Double stars whose two components are almost equally bright are easier to resolve than doubles with one star bright and the other faint. For example, Vega, also known as Alpha Lyrae, is a double. The brighter star is magnitude 0.2 and is separated from its companion by 56.4 seconds of arc. The companion, however, is magnitude 10.5, and is thus inevitably overwhelmed by the fierce intensity of its brighter companion. On the other hand, the two stars of Gamma Arietis, in the autumn sky, are of magnitudes 4.2 and 4.4. Their angular separation is 8.4 seconds of arc, about one-seventh that of Vega, but because the two stars are so nearly of the same brilliance, they can easily be resolved.

For observing close, difficult pairs, choose a night that is clear, when there is a minimum of twinkling in the stars and, of course, when there is no moon at the time you are observing.

Start out with a double that is comfortably above Dawes's Limit for your telescope, and choose a double, if you can, whose components are about equal in magnitude. Try, for example, Gamma Leonis in the outer edge of the curve of stars known as the Sickle above Regulus in Leo. Gamma is a double with a separation of 4″, and

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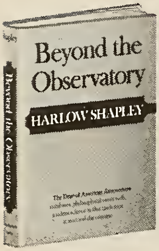

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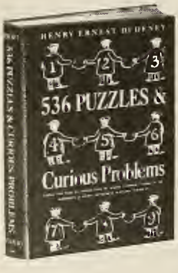

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the two components are magnitudes
and 3.8.

Gamma Virginis is another g
test. It has a separation of about
and the two components are ne
equal in magnitude. 3.6 and 3.7. T
double is just about in the cente
the wide spread of Virgo, about 10
grees above and 8 degrees west
Spica, the brightest star in Virgo.

Neither of these should give
much trouble on a good night. W
you have familiarized yourself
such standard fare. work out on ot
to find the limit of resolution of y
telescope and your eye. Try fai
pairs with a fairly good separation.
example. 2 Comae Berenicis has a
aration of 3.9", but it is faint. The
stars are 6.0 and 7.5 magnitudes.
problem here will probably be find
2 Comae Berenicis in the first pl
Coma Berenices has no bright stars
is, in itself, an expanded open c
ter. Start your search for 2 Co
Berenicis by picking up Delta Leo
the top star in the eastern triangl
Leo. Denebola is the far eastern a
of this triangle. When you have D
Leonis, slide eastward about 15
grees and you should be on 2 Co
Berenicis.

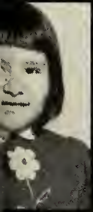
Now try Epsilon Boötis, a
double that was named "Pulcherri
by the Russian astronomer Fried
Struve. Pulcherrima is the Latin su
lative of "beautiful." Here is a lo
double whose components differ
siderably in brightness, 3.0 and
magnitudes. Its separation is 2.8",

Epsilon Lyrae is a famous double-do
Through a field glass, it appears
close double at top, above; with a
telescope, using a power of 100 or
each of the components can also be

andful of people like Mary Carnwath
trying to keep our promise to the Indians.
t they won't make it without you.

e Hopi Indians' village of
lovi in Arizona sits on land
, infertile and inhospitable
far nobody has tried to take
from them.
ctricity has not yet reached
pis. Water must be hauled
ree miles away. Jobs are few
away. Only poverty and des-
e close-by and in abundance.
for the first time in genera-
Mary Carnwath and people
are stirring hope among the

ry Carnwath works and
wo thousand miles away, in
ttan. Her own daughter is
rown-up, and through *Save
ldren Federation* she is spon-
ne of the village girls, 8-year-
ce Mahtewa.
e Mahtewas (two parents,
hildren, one grandmother
sister-in-law) live tightly
in a tiny rock and mud
The father who knows ranch
at can't find any most of the
't able to provide the family
en the bare necessities.



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a fine night and good luck are needed to resolve it, but it lives up to its name. One component is orange and the other pale green.

After awhile, you should have a good idea of the capabilities of your telescope and your eyes, and with some nights of good seeing, you can build up an impressive list of doubles. There are several stars that must be seen from a purely esthetic viewpoint. My own favorite here is Beta Cygni, whose name, Albireo, sounds like a birdcall. Albireo is the lower end of the upright of the Northern Cross in Cygnus. It is easy to find, and its separation of 35″ insures success in resolution. It is, to me, the most beautiful of all the doubles I know. Its components are magnitudes 3.0 and 5.3, and their colors are magnificent. One of the stars is a royal blue and the other a pure gol Don't miss it.

And finally, as a graduation exerci in your course on double stars, go f Epsilon Lyrae. This star is at the upp apex of the tiny, almost equilater triangle in Lyra of which Vega is tl brightest member. It is the famo double-double. The first separation the pairs of this multiple star is 208 Thus, this first separation can be easi seen with a good field glass and, the retically, with the eye alone, which h a Dawes's Limit of about 160″. T second separation should be acco plished with an eyepiece that gives power of 100 to 200 but even then will be difficult to see. The separati of one of the pairs is 3″ and that of t other is 2″. Try some of the doul stars in the following list.

LATE SUMMER OBJECTS FOR SMALL TELESCOPES

This is a list of objects that may be found in August and September.

Catalogue Number	Co-ordinates		Type of Object	Remarks
	RA	Declin.		
IN THE CONSTELLATION OF LYRA				
M-57	18h 52m	+33°	Planetary nebula	Ring Nebula. Small, pale dis Rated mag. 9.
M-56	19h 15m	+30°	Globular cluster	About mag. 8.
Epsilon	18h 43m	+39.6°	Double star	Double double. First separat 208″. Next separation 2.8″ 2.3″. Difficult.
Zeta	18h 43m	+37.5°	Double star	Mags. 4.3 and 5.9; separat 44″.
Eta	19h 12m	+39°	Double star	Mags. 4.5 and 8.7; separat 28″. Three more pairs in power field.
IN THE CONSTELLATION OF CYGNUS				
About 5° west of Alpha Cygni (Deneb) is North American Nebula, but don't count on it. Richest part of Milky Way in northern sky.				
M-39	21h 30m	+48.2°	Open cluster	Large and bright. Mag. diam. 32′.
M-29	20h 22m	+38.4°	Open cluster	2° S. Gamma Cygni, mag. 7.
Beta	19h 29m	+27.8°	Double star	Albireo. Magnificent. Mags and 5.3; separation 34.6. Ro blue and gold.
61	21h 05m	+38°	Double star	Mags. 5.5 and 6.3; separa 27″. First star to have dista measured.
IN THE CONSTELLATION OF VULPECULA				
M-27	19h 57m	+22.6°	Planetary nebula	Dumbbell Nebula. Rated ma Looks almost square in 6-in
IN THE CONSTELLATION OF SAGITTA				
M-71	19h 52m	+18.6°	Open cluster	Compact and bright.
IN THE CONSTELLATION OF SCUTUM				
Whole region is rich; great star clouds.				
M-11	18h 48m	— 6.3°	Open cluster	Wedge-shaped, compact. C double in same field, mag.
M-26	18h 43m	— 9.5°	Open cluster	Condensed cluster in rich f
IN THE CONSTELLATION OF SAGITTARIUS				
Find the Milk Dipper—a small dipper-like asterism whose handle extends to the northwest. Sweep above and west to Mu Sagittarii. Use this star as base of operations. There are 14 Messier objects in Sagittarius.				
M-24	18h 16m	—18.4°	Open cluster	Fine object, mag. 5.
M-17	18h 18m	—16.2°	Nebula	Omega Nebula. Not clearly fined. Dark streak across it
M-20	17h 59m	—23°	Nebula	Trifid Nebula. Hazy but brig
M-8	18h 02m	—24.4°	Nebula	Lagoon Nebula. Beautiful. bright, and exciting.
M-25	18h 29m	—19.3°	Open cluster	Large and scattered.
M-22	18h 33m	—24°	Globular cluster	Finest globular. Rated mag.
M-23	17h 54m	—19°	Open cluster	Faint. Rated mag. 6.9. Wi scattered.
IN THE CONSTELLATION OF CAPRICORNUS				
M-30	21h 38m	—23.4°	Globular cluster	Very bright, mag. 8.
Alpha	20h 15m	—12.7°	Double star	Naked eye double; mags. 4.5 3.8. Fainter star double; m 4.6 and 9; separation Brighter star double; mags. and 11; separation 7″; fai component of this pair is double, 11.2 and 11.5 m separation 1″.
Beta	20h 18m	—14.9°	Double star	Wide double. Mags. 3 an separation 205″.
IN THE CONSTELLATION OF AQUARIUS				
NGC 7009	21h 01m	—11.6°	Planetary nebula	Saturn Nebula. Bright, bluis Mag. 8; diam. 30′.
M-2	21h 31m	—01°	Globular cluster	About mag. 6.3.
Zeta	22h 26m	00°	Double star	Mags. 4.4 and 4.6; separatio

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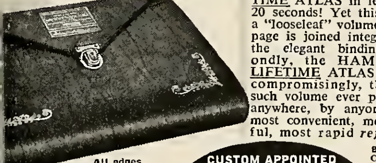

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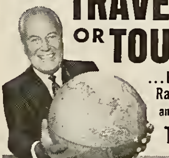

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Underwater movies in a tide pool

by Paul Villiard

Underwater movies are usually considered to be beyond the reach of amateur photographers. The problems of obtaining and financing watertight housings and special camera equipment, as well as those of outfitting oneself for the deep, often appear insurmountable.

But there is a way to take fine underwater movies with a minimum of equipment and investment. The secret lies in a small body of water called a tide pool and in a homemade waterbox. Your repertoire may not feature mysteriously beautiful pictures of the deep caves of a coral cliff, but it will include excellent movies of marine life in its natural habitat. These will be clearer movies, possibly, than those taken in the depths, because the light is stronger, the vision better, and the equipment easier to operate.

Tide pools are wonderful areas that seem to have been invented for the non-swimmer and non-diver so that they, too, could study marine life. The pool can be almost any size from a puddle to a small lake: it may vary in depth from a few inches to several feet, but rarely is it over shoulder depth.

When the tide is high, the pool is generally submerged, and the marine life swims about freely. As the tide recedes, however, the pool becomes isolated from the main body of water, usually stranding the occupants inside until the flooding of the next high tide. But many tide pools have a small neck outlet that allows the creatures to reach the open sea even during low tide. If this is the case, the narrow neck may be blocked temporarily with a number
of stones or some other barrier to k
the marine life within the pool w
you are taking your movies.

To photograph this marine
which is now conveniently entrap
in the tide pool, the camera must
housed in a waterbox, specially m
to provide protection and flexibilit
movement.

The waterbox is an easily built
tainer often used in the Hawaiian
lands (and other places, too, I in
ine) for looking under the surfac
the ocean when hunting fish, shells
corals. It can be adapted quite sin
for motion-picture cameras and
open up a whole new world to the
dent moviemaker.

The box itself is made of redw
or cypress—the latter is preferr
and the inside dimensions shoulc
about sixteen inches square and tl
inches deep. The box should be
sembled with marine glue and b
screws and given two good coats of
best marine varnish available. T
two extra-large gate or barn
handles are fastened to the sides a
six inches below the top edge. Pla
horizontally, these handles allow
to hold the box under the surface
move it about, hunting for and
following the subject.

A rabbet, or groove, is cut on
bottom ends of all four sides to rec
a polished plate glass one-quarter
thick. Examine the piece carefully
fore you have it cut, to make sure t
are no bubbles or surface ripples.
rabbet for the glass should be at
three-quarters of an inch deep to a
the glass to be set in putty, a laye

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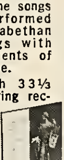

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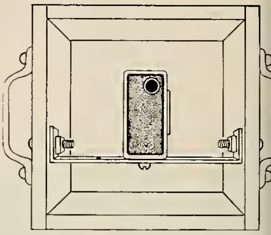
which is forced on the outside underneath the strips of wood that hold the glass in place. The putty should be worked until it is very soft, to make sure that it seals perfectly. It must hold back the water under the considerable pressure that results when the box is forced below the surface. Even better than putty is the elastic aquarium cement sold in almost every pet store and most dime store pet departments. This cement is waterproof and remains elastic for years.

The adapter needed for holding the camera in the correct position is also quite simple. A strip of steel three inches wide, three-sixteenths of an inch thick, and four inches longer than the inside width of the waterbox is bent at right angles at both ends to form two approximately two-inch-long flanges. The ends should be accurately bent so the formed bar will slip snugly into the box, about one inch below the top. It is then bolted to each side using two brass round head bolts and brass nuts. Put the heads of the bolts on the outside of the box. Before installing the bar in the waterbox, drill a hole seventeen sixty-fourths of an inch in diameter in the center of the bar to accommodate the camera screw. Care must be taken to install the bar exactly perpendicular to the bottom of the box. This is important because any deviation from right angles to the glass is apt to produce unwanted reflections from the glass.

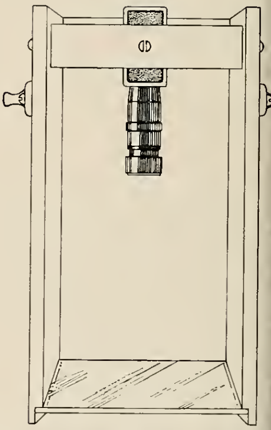
One predictable feature of a waterbox is that it will pop upside down the minute you release it, especially if a camera is inside. Thus you may want to use outriggers to keep the box upright if it is accidentally released. Outriggers can be made of four rods, not less than four feet long, lashed or otherwise fastened in parallel pairs to the bottom of the box. These rods may be bamboo, aluminum tubing, or even strong dowels. A sealed cylinder is then lashed to the outer ends of each pair of rods, to work as a float exactly the way outrigger floats are used on native canoes to keep them from turning turtle in the surf.

The cylinder can be a length of bamboo cut so there is a web or partition closing both ends. It may be a length of aluminum tubing with a circular sheet of aluminum closing each end and secured with epoxy cement. A bar of polyethylene foam is an excellent float and can be easily obtained. In a pinch, an empty bottle securely corked can be lashed to the outriggers. The main idea, of course, is to stabilize the box so it will not tip when you release your hold on the handles. The outriggers make it a bit more cumbersome, but it is better than sacrificing your camera if you think there is the slightest possibility that you will let

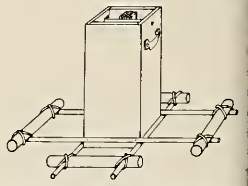
When the waterbox is pushed j
a few inches below the surface, y
will have absolutely clear vision ri
to the bottom. Everything is brigh
lighted by the sun. If the water is sh
low, the exposures should be alm
the same as for normal land use at
same distance. It is best to take a me
reading, however, especially if you
using color film.



The operator's view of a waterbox, f
above: the camera is adjusted through
open top and the box is guided by
handles attached horizontally to the si



A cutaway view of the box: the camer
screwed, as it would be to a tripod
the adapter bar. The face of this
strip must be perpendicular to the g



Outriggers keep the waterbox uprig
released. Fasten four rods to the bo
of the box in parallel pairs; then
sealed cylinders to the ends of each

Each marine specimen will appear be right under your nose, because e sensation of depth is lost. You can llow the subject easily by moving or ping the box, as long as you keep e glass end completely submerged. e camera, being fixed in relation to e bottom of the box. is always pointg at the subject. Thus you can follow crab stalking its prey, filming as you , and include the capture and the lining room" scene.

In tropical waters you may be fornate enough to discover a group of idibranchs (*see* NATURAL HISTORY, ugust-September, 1966), or even a ngle one. Their graceful, undulating otion, as they swim about nosing at e seaweed and algae near the fringes the pool, makes an excellent film. he colors of the nudibranchs are faustic. Deep orange, enamel white, ight green; spotted or striped—they e infinitely varied in color and design.

Perhaps you will come upon a starh hiding under a rock. Dig up a nall clam and drop it on the starfish. ou may be able to film a scene of the ntacles of the starfish as it opens the am enough to insert its stomach and ed on the succulent meat inside.

If you find a moving line in the nd, gently brush away the sand to pose whatever is underneath. The ances are you will find an olive shell, perhaps a murex, making its endless ay along in the search for food.

A trip to a tide pool will reveal scene ter scene in the daily lives of marine eatures industriously going about eir business. Many of these scenes ay be captured on your film.

After each use, wash the waterbox oroughly with fresh water, and dry with a soft cloth. Pay particular atntion to the removal of all the salt ater, and dry both sides of the glass that the sea water does not etch the rfaces and cloud them.

If the box has been stored for many eeks or months without use, it may rink to a point where it fails to hold it the water. If this happens, fill the x with fresh water overnight to swell e seams tight again before restoring to service. Then dry the inside oroughly before installing the camа; use a lint-free cloth on the glass, d be sure to remove all the water om the seams and corners. It is frusating to watch a trickle of water run ross the glass in front of the lens just you are filming a particularly desirle specimen.

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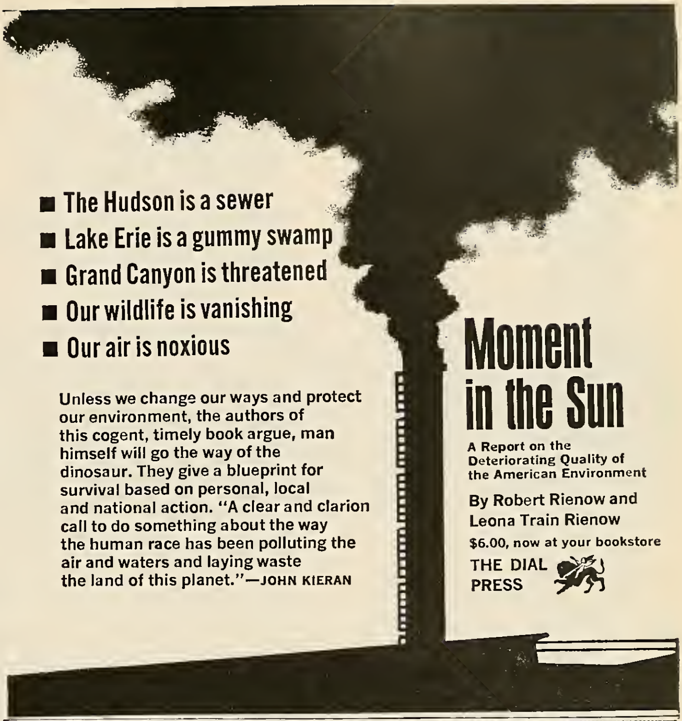
ul Villiard is a free-lance writer, otographer, and naturalist. A freent contributor to Natural History, r. Villiard has also written several oks on a variety of topics.



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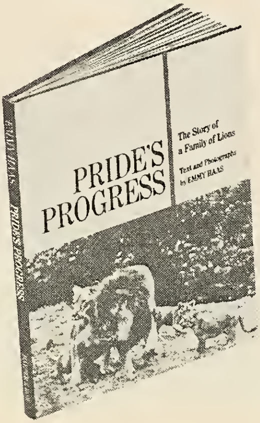

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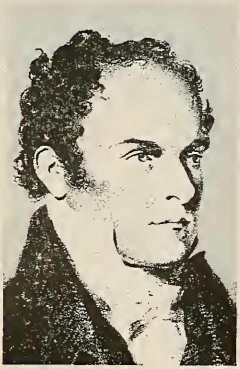
The Story of a Family of Lions
Text and Photographs by EMMY HAAS



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Diary of an anthropologist

by Marvin Harris

A Diary in the Strict Sense of the Term, by Bronislaw Malinowski. *Harcourt, Brace, & World, Inc., $6.95; 315 pp.*

Widely accepted as the century's greatest ethnographic work, Bronislaw Malinowski's Trobriand Island studies (*Argonauts of the Western Pacific*, 1922; *The Sexual Life of Savages*, 1929; *Coral Gardens and Their Magic*, 1935) powerfully influenced current standards of ethnographic description. Compendious, yet marvelously detailed and unsurpassed for their subtle presentation of the "native's" point of view, Malinowski's ethnographies are essential to the understanding of contemporary anthropological theory. From their corpus of materials, the main anthropological challenge to the Freudian system arose. The Oedipus complex, said by Freud to be the universal and central feature of the human personality, was held by Malinowski to be greatly modified or possibly absent altogether among the matrilineally organized Trobrianders. Malinowski also made the inhabitants of these islands off the southern tip of New Guinea famous for the Kula, an elaborate system of trading partnerships that governed the circulation of insular products. Equally important to anthropologists is his analysis of the function of prestige in Trobriand economic behavior and the contribution of magic to the organization of work. Indeed, there is scarcely a single facet of the "universal pattern" for which the knowledge of how the Trobrianders "do it" is not a must.

The publication, twenty-five years after Malinowski's death, of diaries written during his stay among the Trobrianders and neighboring peoples promised to be an event of no little interest. There are many questions concerning Malinowski's field work about which such a diary might prove illuminating. We need to know more about how he selected his informants, how he got them to work for him, how he scheduled his interviews with them. We are curious about the extent to which he supplemented his talks with observations of actual behavior, how framed his working hypotheses, a why he decided to emphasize cert ethnographic subjects while negle ing others.

These expectations are unfortuna ly not destined to be fulfilled. As M nowski's student Raymond Firth marks in the introduction, the diar that have just been published "can be ranked as more than a footn to anthropological history." They astonishingly barren of direct insi into Malinowski's professional pl and procedures. They consist inste almost entirely of expressions of inner psychological turmoil that beneath the brilliantly poised exter of this supreme field worker.

It is soon clear that these are inner thoughts of a man under gr psychological stress, rather than professional log of an anthropolog on a field trip. In theory, the substa should be no less interesting, for M nowski was an extraordinarily gif and educated man. Born in Poland, obtained degrees in mathematics a physics at the University of Crac before enrolling in the London Sch of Economics and commencing his thropological career. In his acqui command of English, he resemb Joseph Conrad, a figure with whom evidently closely identified. A brilli conversationalist, tireless reader poetry and novels, urbane in the gr tradition of the Polish intelligentsia, nonetheless elected to spend a c siderable portion of his youth living a tent with no one to talk to but St Age villagers, an occasional pe trader, and a grab bag of missionar To be party to the inner thoughts such a man under such conditi might be an unusual privilege. once again, the promise remains un filled. Much of the diary consists c monotonous catalogue of psycholog depressions and recoveries, phys illnesses and the medications measures taken to restore phys health. Day after day, the book dominated by terse entries alluding despair, loneliness, longing, and de wishes. Fevers, vomiting, diarr

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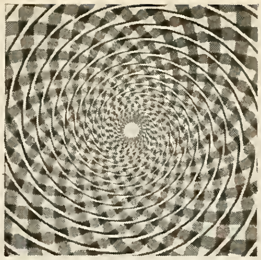
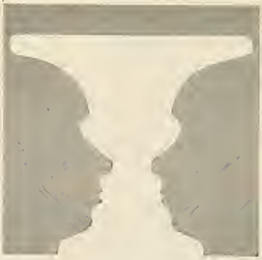


Illusion—the mind insists on seeing these concentric circles as a spiral.



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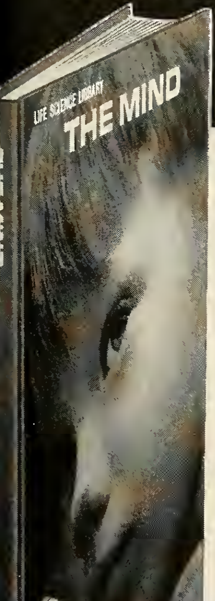

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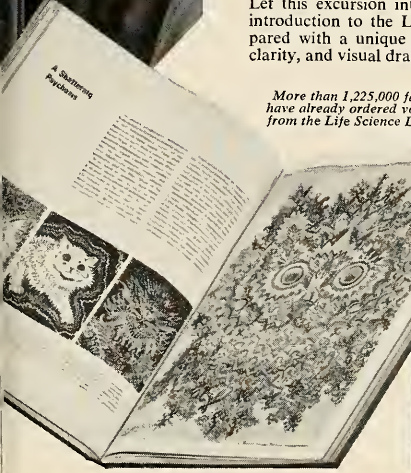

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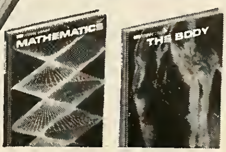

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–This Year–

Reservations for most 1967 tours are closed, and many have been completed. Enthusiastic "veterans" will testify to a fine spring season in North America, the Mediterranean (where the famous Coto Doñana in Spain shared honors with the Camargue, Corsica and Greece), Great Britain, Scandinavia and Iceland. There are still openings for the greatest series of all—the South Pacific, Australia and New Zealand, where our autumn is their spring.

— SOUTH PACIFIC —

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NEW ZEALAND: Comprehensive 3-week coverage of both islands, working south with the spring. Geysers, glow-worm caves, majestic Mt. Cook and Milford Sound. Nov. 18.

N.Z. BOTANY: Two weeks up the west coast in a land of strange plant life and magnificent glaciers. December 9.

HAWAII: Our Xmas party this year is at the Volcano House, Kilauea Crater, followed by a 10-day bird-and-scenery tour of the islands.

–Program for 1968–

We cover the wildlife of the world on a 3-year cycle, visiting some areas annually. Here is the expected program for 1968. North American tours are 2 weeks each, overseas 3 weeks, and are set up in chains of 3 or 4 trips, in case you wish to stay longer.

NORTH AMERICA: Florida, Jan. 27. Texas-Northeast Mexico, Mar. 23. S.E. Arizona, May 4. Sierras, June 1. Cascades, June 9. Maine & the Gaspe, June 29. Newfoundland-Labrador, July 13. Alaska in three 2-week stages beginning June 8 or July 6, expanding the highly successful series of 1967 trips.

MIDDLE AMERICA (2 weeks each): Yucatan, Feb. 10. Mexico East Coast, Feb. 24. Mexico West Coast, Mar. 9. Northwest Mexico, May 18. Chiapas, July 13. Yucatan, July 27. Guatemala-Honduras, Aug. 10. Costa Rica-Panama, Aug. 24.

SOUTH AMERICA (3 wks. each): Colombia (world's top bird country, which we visit twice yearly), Feb. 10 and Aug. 10; Guianas-Venezuela, Mar. 2. And a series of tours around the continent beginning with Ecuador-Galapagos, Sept. 7.

EUROPE: The Europe program makes possible many combinations: Greece migration, Apr. 20. South Europe, May 11. Mediterranean, May 11. Norway, June 1 & June 23. Britain, June 1. Balkans, June 1. Iceland, June 22. Russia, June 22.

AFRICA: South Africa, July 20. East Africa, Aug. 10. Probably also two others of our 6-tour Africa repertoire, including Madagascar.

ASIA: Japan, May 18. Next coverage of other parts of Asia early in 1969: Philippines; Thailand-Malaysia; India-Ceylon; Himalayas.

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rapid pulse, weak heart — against these states there are countless prescriptions of arsenic, quinine, calomel, Epsom salts, iodine, aspirin, walks on the beach, Swedish gymnastics, and enemas. Another large portion of the text consists of beautiful, but unenlightening, scenic descriptions — of the clouds, the sea, the beach, the colors of the sky. These too apparently fulfilled some sort of therapeutic function, connected with Malinowski's sex life. Contrary to legend and rumor, Malinowski shunned sexual contact with the native girls, despite their availability as defined by both aboriginal and colonial custom. He treated his sexual cravings as a kind of disease — a threat to his existence that had to be overcome by a superhuman effort of the rational and conscious will. To think about sexual relations with women in general, or women at random, was a betrayal of the integrative forces of his personality. Again and again, he berates himself for his "lecherous thoughts." To a certain extent these lecherous thoughts concerned a desire to sleep with the native women, an act that along with masturbation and whoring, he describes as "sloshing in the mud." Speaking of a particular adolescent native girl as having "an animal-like, brutishly sensitive face," he cannot repress a "shudder at the thought of copulating with her." There are two antidotes for this sex-sickness in Malinowski's pharmacopoeia. One is the allegedly purifying effect of the unpeopled horizons of land, sea, and sky. In the "beauty of a landscape" he sought to "rediscover woman's beauty," and it is this discovery that liberates him from "the fetters of sensual pleasure." The second remedy is to concentrate his desires for women in general upon one woman in particular, namely his future wife, Elsie R. Masson. Thus, page after page of the diary bears witness to a Manichaean contest between good thoughts of "E.R.M." and lecherous thoughts about native girls and missionary matrons.

Very little of this seems likely to enhance Malinowski's reputation as a man or an ethnographer. To make matters worse, there are repeated expressions of contempt for the natives, often referred to as "the niggers," including his best informants. At various junctures, he confesses "a general aversion to niggers," his need to run away from them, and his wish that they would cease to exist. Thus, the portrait that emerges from the diaries is, to say the least, extremely unflattering. Not only does Malinowski reveal himself as a hypochondriacal, puritanical, egotistical, ethnocentric snob, but he appears to be the very quintessence of ethnographic ineptitude, blundering from place to place, guided only by a cru surmise of what it would take to l come famous. But it is this last featu which gives the lie to the whole se portrait. We know from the testimo of Malinowski's enduring works th the retching and complaining we counterbalanced by prodigious feats organized inquiry. Furthermore, know from the profundity of his i sights into Trobriand life that he cou not have disdained the human relatic ships, the daily give-and-take, so d tinctive of anthropological field wo Were there no other hypotheses, o would be tempted to declare the diaries the work of a clever but p verted enemy seeking revenge agai Malinowski for an ancient wrong.

There is a simple explanation, ho ever, by which the contemptible lit prig of the diaries may be reunited wi the giant of the *Argonauts*. The diari were obviously an important part Malinowski's medical kit. Just as doctored himself with quinine agai malaria, so he wrote in his diari warding off the personal dissoluti that threatens those who venture to ca themselves away among a distant a alien people. Malinowski's diaries t us only as much about Malinowski a man as we might learn were all of t empty vials and packets of his medi ments suddenly to wash up again Port Moresby. In my opinion, Malino ski's second wife, Violetta, has serv neither her husband nor anthropolo in bringing this melancholy fragm into public display. Finally, it sho be noted that the whole enterprise made even more unpalatable by t substitution of three dots for passa that in the original referred to what described as "extremely intimate servations." If there was to be any gard shown for Malinowski's priva and his reputation, these diaries sho never have been made public. But the editors to presume to know wh passages he would have first wanted delete is an insult not only to Malin ski but to the reader as well.

Dr. Marvin Harris is Professor of thropology at Columbia University is presently writing a history of theories of cultural anthropology.

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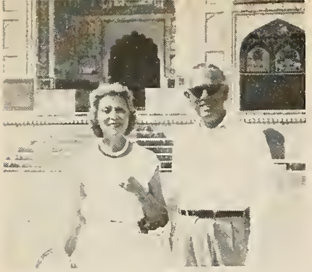

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and Thomas Poulson have produced a book that will fascinate not only anyone new to caves and their inhabitants but the most able spelunker as well.

This book, the latest in the "Our Living World of Nature" series, introduces the reader to the fauna of caves with an ecological approach, rather than the usual pictorial biography of each animal. By relating all the animals to the food chain, explaining their adaptation to the environment, and interspersing anecdotes throughout the text, the authors have achieved a truly interesting approach to the field of biology.

The Life of the Cave is accurately and colorfully written, with an attention to reader interest that only a writer who loves his subject can give. Both of the authors are well known for their work in speleology as well as biology; Charles Mohr is probably the leading man in cave exploration and study in the United States today.

The illustrations alone are worth the price of the book. Almost every illustration is captioned with a concise paragraph of explanation. The photographic representations are handled with remarkable accuracy.

The ecologically oriented text consists of four chapters, each dealing with a particular facet of cave ecology, such as food chain, adaptation to darkness, etc. There is an appendix consisting of lists of commercial and National Parks' caves, scientific names of the animals represented, an excellent glossary, and a few pages entitled "How to Become a Spelunker."

It is my opinion that most of the appendix is unnecessary, especially "How to Become a Spelunker," but on the whole, I feel that this book will be of great interest to any novice to the wo
of caves and a refreshing and pleas
addition to the most experienced c
biologist's library.

J. Mark Odi
University of Maryl

A Field Guide to the Birds of N
Zealand, by R. A. Falla, R. B. Sibs
and E. G. Turbott. *Houghton Mif*
Co., $6.95; 254 pp., illus.

New Zealand, an isolated and r
tively small commonwealth,
long needed a first-class bird gui
This one will be much used at ho
and probably even more by consta
increasing visitors to the Dominion

The native land birds of the m
islands and their many outliers con
tute a rather limited avifauna, but
of extraordinary interest because
the high proportion of species,
even of families, found nowhere e
The kiwis; the kakapo, or flight
parrot; and the supposedly extinct,
recently rediscovered, takahe—a bu
flightless, purple moorhen—are th
examples.

In contrast, the water-bird life
New Zealand is close to the riches
the world. Eleven types of pengu
nearly all the albatrosses and pet
of the southern oceans, gannets,
morants, grebes, ducks, skuas, gu
terns, and waders breed there, man
spectacular variety and abunda
Furthermore, the islands lie at
southern end of the migration route
numerous oceanic and wading bi
from high latitudes in the North
Hemisphere.

The three authors, with all
whom the reviewer has gone afiel

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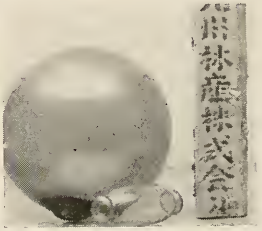

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their own bailiwick, rank with foremost ornithologists the world around. They have been thorough, appreciative, and bold. A striking instance of the last trait is their elimination of numerous specific names that are usually inserted between genus and racial names. The Chatham Island mollymauk, for example, is properly a subspecies of another and more widely distributed albatross. But the Chatham bird is of such different appearance that it can be readily distinguished in the field. The authors therefore list it as *Diomedea eremita* instead of *Diomedea cauta eremita*. For a practical, identifying handbook, this is to be enthusiastically commended. It will help observers and not confuse experts. Miss Talbot Kelly's drawings in color and black and white are simple, direct, and look like the birds. What more could one ask? If a better book for its purpose is ever done, it will probably be by the same authors.

ROBERT CUSHMAN MURPHY
The American Museum

ETRUSCAN ART, by Raymond Bloch. GREEK ART, by François Chamoux. Vols. I and II of "The Pallas Library of Art." *New York Graphic Society, $10.00 each; 103 pp. and 102 pp., respectively, illus.*

Two fine European scholars have written concise introductory essays on the ancient arts of Greece and Etruria; excellent reproductions of ancient works have been superbly printed. Thus, another popular art series is begun with the first two volumes at $10.00 each. For whom are these books intended? The editor, in a prefatory note, speaks of the "educated reader." Now, an educated reader is a euphemistic label for a state of being somewhere between "egghead" and "square." Why is this series being published? To present, continues the editor, "the manner in which societies are fulfilled through their art." But no society (least of all one of which we have only the most fragmentary evidence) can be fulfilled—be completely realized or manifest—in its art.

This reader is then left to his own suspicions, which are that the books are intended as handsome gift suggestions for the coffee or end table. There are several such art publishing ventures today. They all share the fault of pretending to high cultural ideals and perpetuating the notion that the enthusiasm of casual acquaintanceship is a viable substitute for hard-won familiarity that breeds understanding, insight, and perceptiveness. And, thus, the popularized book is born as a corporate endeavor: commission or reprint in part a long essay, gather together

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some handsome pictures, and arrange the material according to the dictates of eye-catching layout. The author describes works that are not illustrated; many works pictured are not mentioned in the text. Scale, sequence, and continuity of illustrations are lost at the drawing board. Works are illustrated without showing the complete object.

Having made this dyspeptic cry against the totalitarian rule of sales and market in book publishing, one must go on and recognize the positive aspects of these two volumes. The authors of the essays give excellent, brief accounts of the two cultures in terms of their art and architecture. The development of style and taste over the several centuries is boldly sketched at a sprightly pace. The individual color illustrations are as good as one could hope for, returning to the works of art a sparkle and liveliness that will be a delightful surprise to many readers.

But brief essays about great ranges of time and materials always run the danger of engaging in generalizations that do not bear close examination. For example, the elegant decoration on Etruscan bronzes is cited as testimony of the "Etruscan's joy of living." We must remember, however, that such expensive works were not made for the common market; indeed, these works are preserved for us in the tombs of the ruling upper-class Etruscan families. Hence, while they may tell us about the tastes and the attitudes of the wealthy, they hardly inform us that the great masses of the Etruscan cities had a "joy of living." Certainly we would not use the palace of Versailles as a measure of an eighteenth-century Frenchman's spiritual state.

BERNARD GOLDMAN
Wayne State University

THE MAYA, by Michael D. Coe. *Frederick A. Praeger, $7.50; 252 pp., illus.*

DESPITE a widespread popular interest in Maya archeology, there has been a scarcity of adequate and up-to-date reviews of the subject—for the obvious reason that such are not easily written. It is a complex field, requiring an author who not only controls a vast amount of information but is aware of the most recent trends in interpretation, and who also has the ability to condense and summarize the many complexities in a generally understandable way. Dr. Coe meets these requirements with ease, and this book now takes first place on my list of recommended reading on the Maya.

The book is designed to be an introduction to the subject, but like most of the books in the "Ancient Peoples and Places" series, it is an introduction on a high level and requires some application by the reader, or some
vious knowledge of Maya archeol
to be fully understandable. A g
number of illustrations are inclu
but many of these are of newly
covered or exceptional objects,
one would have to go elsewhere f
look at many basic materials. The
to do this is provided, however, by
excellent listing of sources for fur
reading. This is a book that will b
great service to the really intere
reader and will serve also as a good
vey for college courses in gen
archeology.

In any treatment of this kind, wh
space is severely limited, an au
must make a drastic selection of
materials he will cover and must so
times forge ahead through con
versial subjects without fully iden
ing them as such. It would be possi
therefore, to discuss and criticiz
number of points, but, generally sp
ing, these are minor ones and do
mar the over-all excellence of the b
There are also some editorial la
that will create some confusion. I
stated, for instance, that there are
great pyramids at Uxmal—the Ten
of the Dwarf and the Temple of
Magician. These are two names for
same building. Also, the great
court at Chichén Itzá is 119 feet w
not 199 feet as stated.

I can only express my delight in h
ing a book that can be recommen
with enthusiasm to anyone who wis
to discover what is being learned of
ancient Maya.

GORDON F. EKH
The American Mus

THE EARTH, by Carl O. Dunbar. *W*
Publishing Co., $12.50; 252 pp., il

PROFESSOR DUNBAR is one of
foremost teachers of geology in
time and has been noted for his cla
of thought and expression. These
tributes have been carried over
this interesting volume on physical
historical geology.

An introductory chapter briefly
lines the development of thought
garding the nature of the earth an
relationship to the universe from G
to modern times. This is followed
two chapters on the concepts of
logic time and the earth's place in
universe. The next three chapters f
on the structure and composition of
earth (the lithosphere, the hy
sphere, and the atmosphere). The
jects contained in these early chap
would be included in most textb
on physical geology. The last par
the book utilizes principles develo
in the foregoing chapters to trace
history of the earth. Here again
author takes the traditional appro
by beginning with the origin of
solar system. He then elucidates

rmation of the earth, the atmosphere, e oceans, and continents. Chapter 9 ·als with the processes that have ulptured the exterior of the earth. vo further chapters amplify the thesis veloped in chapter 9 by discussing imatic changes and theories involving ternal forces possibly responsible for e formation and distribution of land ısses. The final chapter is a brief ɔk at the fossil record; the account so brief, in fact, that it is the least fective chapter. This is surprising; ıleontology is Dr. Dunbar's specialty. With the exception of the chapter on ssils, he has presented up-to-the-min- e developments of geology including sults of the Ranger Lunar program. ı the whole, the book is smoothly and ıerestingly written. As Dr. Dunbar ıtes at the beginning, science jargon reduced in order to bring forth as ·arly as possible the complex phe- mena of the earth. As such, the book ll undoubtedly do yeoman service · the interested teen-ager or general ıader. However, it is not a textbook.

There are some negative points that ım obligated to report. The chapter fossils would have been far more ective had it included illustrations of ɜ fossils discussed. Curiously, Dr. ınbar did not mention some of the ·cent developments in the field of pale- tology. He has omitted important re- ıt discoveries of metazoans in the ecambrian and some of the newer d exciting concepts on the origin of ɜlled metazoans in the Cambrian and ɜ origin of life itself.

Finally, the book would have been re effective had there been a more ·ughtful job of editing. For example, page 225, one whole paragraph is npletely out of context. "The pag- ıt of life throughout geologic time is ated in detail by Dr. A. S. Romer in ume 4 of this treatise. . . .": no trea- ɜ is mentioned before or after the ·agraph, there is no reference to Dr. mer in the bibliography, and in the hor index Dr. Romer is cited on ɡe 226 [not there]. Since the book is ɔlished, and is primarily to be dis- ɔuted, in the United States, it is a her curious affectation that the edi- s (even though they appear to be ·tish) choose British spelling for ·h words as *center*, *color*, and *vapor*.

ROGER L. BATTEN
The American Museum

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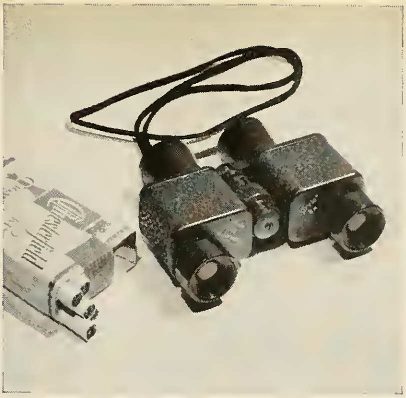

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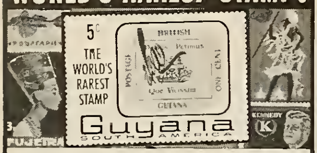

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FORTY YEARS OF LANDSCAPE ARCHITECTURE. F. L. Olmsted. L. P. Putnam Sons, New York & London. 1928.

CENTRAL PARK—A HISTORY AND A GUIDE. H. H. Reed and S. Duckworth. Clarkson N. Potter, Inc., New York, 1967.

CENTRAL PARK—GRAND DESIGN OR CATCH-ALL? A map prepared by R. E. Harrison. Greensward Foundation of New York City, 1967. (Copies available at 10¢ each from Friends of Central Park, Planetarium Station, P.O. Box 12, New York, N.Y. 10024.)

FROM THE LOG OF THE "TE VEGA"

THE GALATHEA DEEP-SEA EXPEDITION. A. F. Bruun. Macmillan, New York, 1956.

THE SILENT WORLD. J. Y. Cousteau. Harper Bros., New York, 1953.

THE LIVING WORLD OF THE SEA. W. J. Cromie. Prentice-Hall, Englewood Cliffs, 1966.

THE ADAPTIVE IBIS

FLORIDA BIRD LIFE. A. H. Howell. Florida Department of Game and Freshwater Fish, 1932.

CONSOLIDATION OF NORTHWARD EXTENSION OF THE GLOSSY IBIS'S BREEDING RANGE. J. P. Hailman. *Bird-Banding,* Vol. 30. pages 231-232. 1959.

MUSEO NACIONAL DE ANTROPOLOGIA DE MEXICO

THE NATIONAL MUSEUM OF ANTHROPOLOGY, MEXICO. P. R. Vasquez, *et al.* Harry N. Abrams, Inc., in assoc. with Alexis Gregory, New York, 1967.

SONS OF THE SHAKING EARTH. E. Wolf. University of Chicago Press, Chicago, 1959.

MEXICO. M. Coe. Frederick A. Praeger, New York, 1962.

100 TURTLE EGGS

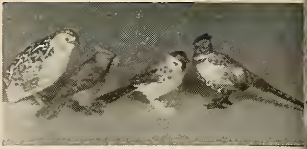
THE WINDWARD ROAD. A. Carr. Alfred A. Knopf, New York, 1956.

THE GREEN TURTLE AND MAN. J. J. Parsons. University of Florida Press, Gainesville, 1962.

SABLE ISLAND

GEOPHYSICAL OBSERVATIONS ON THE HISTORY AND STRUCTURE OF SABLE ISLAND. P. L. Wilmore. *Transactions of the Royal Society of Canada,* Third Series, Vol. 50, pages 13-20, 1956.

SABLE ISLAND. H. St. John. *Proceedings of the Boston Society of Natural History,* Vol. 36, No. 1, pages 1-103, 1921.



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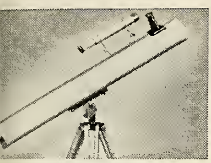

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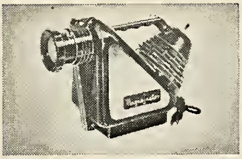

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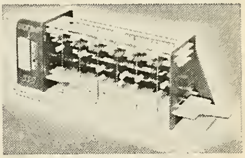

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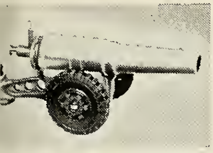

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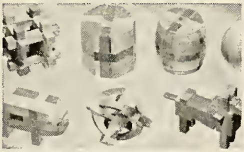

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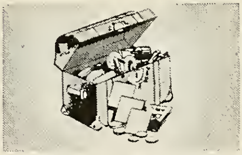

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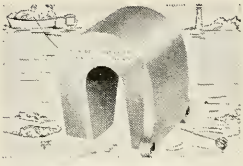

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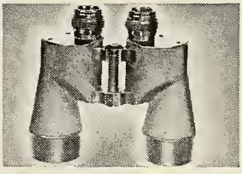

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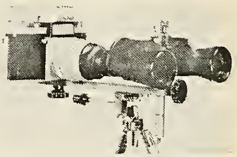

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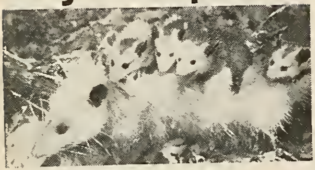

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Letters to the Editor

Chicken Welfare

In the May issue of NATURAL HISTORY, as I remember it, Marston Bates stated in his column that nobody had worried about the well-being of chickens raised in these large mass-production poultry farms —or words to that effect.

However, I must call attention to the fact that my late colleague, Roy Bedichek, with whom I corresponded at considerable length and whom I never met, although we were both on the University of Texas staff, has worried about these chickens quite considerably. His general thesis was that since most of these hapless fowl are kept in enclosures with a poultry-wire bottom and cannot scratch the substrate at all, they go crazy. He went on to say that neurotic chickens do not taste good and that their eggs were influenced somehow and that yard eggs from chickens raised in a natural environment around a small farm were much better than those from the mass-production poultry houses.

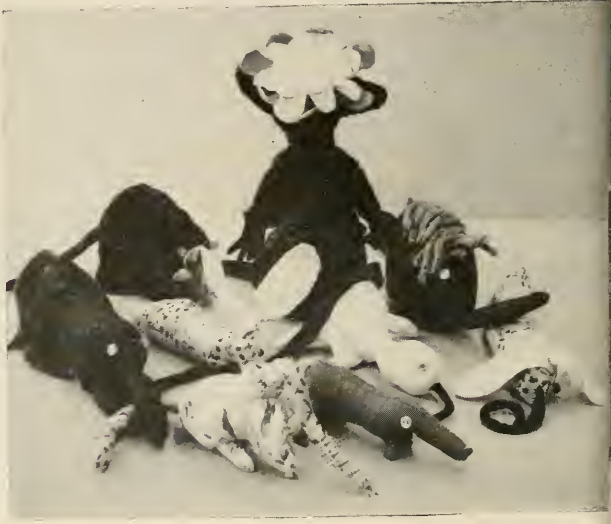
GORDON GUNTER
Gulf Coast Research Laboratory
Ocean Springs, Mississippi

Again, the Snouters

The renewed interest in the snouters prompted me to offer you some background about the origin
these fabulous exotic animals. I
told by Dr. Traute Schroeder h
Dr. Steiner drew nasobems for
children in the postwar years w
no children's books were availa
in Germany. One day his drawi
were seen by his colleagues at
Zoologic Institute and they p
suaded Steiner to publish them.
presented some of them at an In
national Congress where they w
taken quite seriously, in partic
by Eastern European nations.
parently some real publications
peared subsequently, until Stei
was forced to renounce his pa
Still, some continued to believe
this was a real thing.

EBERHARD PASSARGE, M
Division of Human Gene
The New York Hosp
Cornell Medical Ce

The mythical snouters, descri
in the April issue, provoked an
traordinary amount of fan mail.
creatures proved unusually prov
tive to the fourth-graders at N
York's Ethical Culture School, w
presented NATURAL HISTORY wit
small band of stuffed snouters,
tured below. The animals are do
well. Ed.



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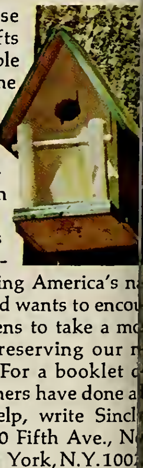
Most birds would die if they couldn't migrate, and they must travel a precise route. One such route goes right through Dr. Gaillard's country near Mobile, Alabama. There, on Dauphin Island, song and game birds from much of the U. S. feed and rest on their way to or from Central or South America. Often, it's a 600-mile, non-stop flight.

But people began using up the land on the Island, leaving less and less food and shelter for birds. The door to migration was closing. That's when the Doctor and his friends started moving the earth. People and organizations got together, bought the necessary land, hired earth-moving equipment, scooped out stagnant swamp-beds, changed them to fresh-water lakes by sinking artesian wells. They planted bird food, cleared underbrush, tested soil, grew shrubs and flowers, brought in pheasants, quail, minnows, crawfish, crickets, earthworms, and even bees for pollination. They traded the scooped-out soil as full payment for the excavating. Any trees that had to be cut were sold for lumber. Now the birds are thriving, and the people have a beautiful park. Next time you hear a bird sing, it could be through the courtesy of Dr. Gaillard and his friends. Listen carefully and you'll get this message: the wise use of nature's gifts ...animal, vegetable or mineral...is the responsibility of every American. Each one of us can help, probably more than you suspect.



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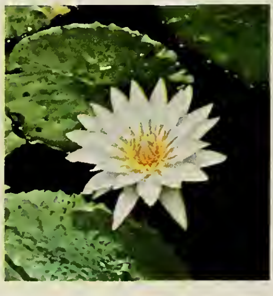

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Natural History

Gregarious Mountain Sheep

Where Do the Turtles Go?

The Hippie Hang-up

A PROPOSITION

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As its name imp **Avant-Garde** will be a for directed, daring, and wildl donistic magazine. It will r on every aspect of the ebu new life-style now emergi America, and it will do so wi put-ons and no inhibitions.

The pages of **Avant-** will explode with biting sati cisive profiles, audacious re age, lush graphic art, consc ness-expanding fiction, and p that *speaks.* **Avant-Gard** cover Art, Politics, Science every other subject of inter readers of superior intelli and cultivated taste. It will bimonthly of:

—*beauty,* bringing to graph a transcendental new kind of

—*truth,* eschewing platitude really telling it like it is; and

—*love,* unabashedly reveli the One Universal Ultimate

In short, **Avant-G** will be a hip, joyous, bea new magazine. It will be the of the Turned-On Generati

Perhaps the best w describe **Avant-Garde** for to list the kinds of articles print:

e Dead-Serious Movement to Run Allen nsberg for Congress

mage to Muhammad Ali—35 Celebrities cluding Marlon Brando, Jackie Robinson, l Woody Allen) in praise of Cassius Clay.

ming: Synthetic (and Therefore Legal) rijuana

dio Free America—A professor's plan eady in motion) to establish a pirate radio ion off the coast of California.

e "Bust" of Charlotte Moorman—The ed young cellist describes her arrest for ing a concert hall recital "topless."

e CIA's Super-Salaried "Super-Spook"— exposé of an operative who is paid $1 lion a year to fink for Big Brother.

e Intellectual Companions of Jacqueline nnedy

b Dylan's Suppressed—and Pithiest—Song rics

vador Dali: A New Dimension in Erotic—Drawings created especially to celebrate launching of **Avant-Garde.**

orge Romney's Bizarre Religious Beliefs

ward the Elimination of War—A little-own exchange of correspondence between stein and Freud.

derstanding Zowie—A glossary of itched-On Generation jargon.

e Fugs—New York's most way-out elec-nic raga-rock nerve-thrill company.

Gastronomical Guide to the Year 2000

e Writing on the Wall—The emergence of ffiti as a medium of social protest.

ve Over, Lady Chatterley—A preview of eral erotic classics soon to be published his country for the first time.

e Prison Poems of Ho Chi Minh

xed-Media Art: The Pop World's Newest rambled Oeuvre"

Love for You Is Stronger than Dirt— Madison Avenue dating scene as ob-ed by Dan ("How to Be a Jewish Mother") enburg.

ts at War—Bitter anti-war verse by GI's ietnam.

n Lennon as a Master of Prose

enious—and Perfectly Legal—New Ways und Abortion Laws

rett Dirksen as "The Wizard of Ooze"— op Impression.

Emergence of Abstract Expressionist rnalism—As exemplified by the L.A. **e Press, N.Y. East Village Other,** and **keley Barb.**

up Psychotherapy on TV

rey Beardsley's Suppressed Erotic Works portfolio.

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nographic Film Festivals at Lincoln Cen-y 1970—Predictions by an underground -maker.

In sum, **Avant-Garde** will a feast of gourmet food-for-thought prepared by the avant-garde for the avant-garde. It will be the quintessence of intellectual sophistication.

The creative director of **Avant-Garde** is one of the most fertile minds in American publishing today: Herb Lubalin, the country's foremost art director (it was he who designed the elegant —and cruelly suppressed—quarterly *Eros*). In addition, the staff of **Avant-Garde** includes several of the most gifted artists, writers, and photographers of our time.

In format, **Avant-Garde** will more closely resemble an expensive art folio than a magazine. It will be printed by costly offset lithography on the finest antique and coated papers. It will be bound in 12-point Frankote boards. It will carry *no advertising whatsoever.*

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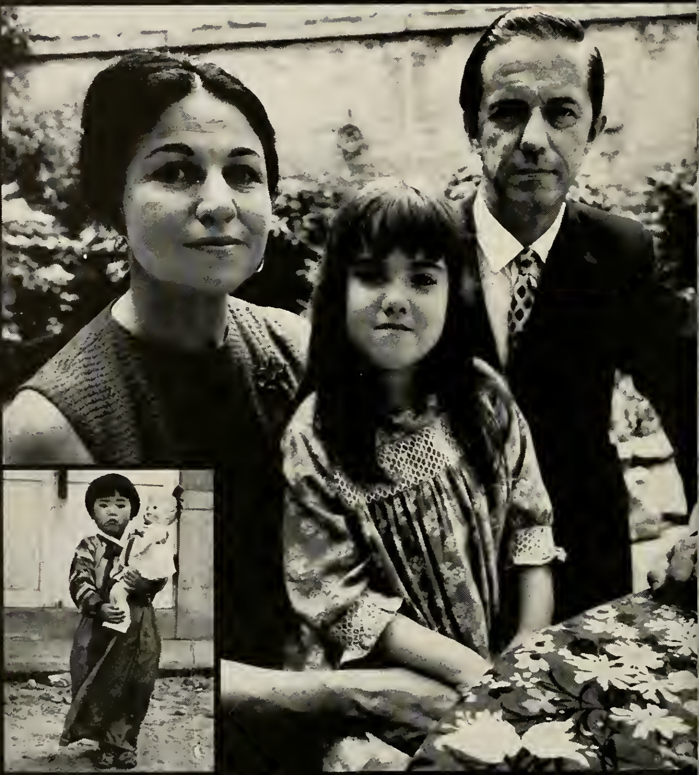
Nancy and John Seletti aren't trying to save the wo Just a little piece of it.



About a mile outside the Korean village of Ku Am there are a few dozen young, still-tender mulberry trees growing on a small hill. Someday these trees and their succulent leaves will be the heart of a new village industry—a silk raising farm. That day is still many months off, but it doesn't stop the village men from making daily inspection treks up the steep hill, just in case. Just in case something miraculous has happened since yesterday. After all, it wouldn't be the first miracle to happen in Ku Am. Everyone in the village knows the story of Chang Sook, the daughter of the widow.

Ten years ago Chang Sook's chances of survival were as slim as she was. Her father had disappeared during the family's flight from North Korea. Her mother, a seamstress, worked a backbreaking day and most of the evening to earn $10 a month. Barely enough to keep them from starving.

But today that's all changed because an American couple named Seletti are sharing a little of their good fortune with a girl to whom a little means everything. Nancy, John and five-year-old Alexandra Seletti are New Yorkers. They're not fabulously wealthy as the villagers of Ku Am believe. But, they're not poor either. *Comfortable* probably describes them best. They have everything they really need, but give them ten minutes and they'll come up with ten things they want that $15 a month would buy. Luckily, they thought of Chang Sook first.

Through Save the Children Federation, the Seletti's $15 a month is doing a remarkable number of things. First, Chang Sook's immediate needs and future schooling are being taken care of. The family is getting help, too: Enough to enable Chang Sook's mother to start a small knit shop.

And with all this, there is still some money left over. This money, together with money from other sponsors, was borrowed by the village to start its precious mulberry farm. Someday silk raising will mean a permanent increase in the village's income—and permanently end the need for charity. That's what Save the Children Federation is all about. Although contributions are tax-deductible, it is not a charity. The aim is not merely to buy one child a warm coat, a new pair of shoes and a six month supply of vitamin pills. Instead, your contribution is used to give the child, the family and the village a little boost that may be all they need to start helping themselves.

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Chang Sook writes to the Selettis. She also sends small homemade gifts to Alexandra. And she tells them of her dreams of becoming a nurse. She'll probably make it. If she does, the Seletti's investment in girl will be repaid a thousand

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IS XEROX *DEAR?*
IS UNION CARBIDE A *GROWTH* STOCK?

When you try to put your finger on the meaning of these familiar words, you find as often as not that it has changed. What is **speculative** to your banker may be **growth** to your broker. What seems **safe** to your father can sometimes smell of **stagnation** to your son. **Dear** in one man's eyes is **cheap** in another's.

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Natural History

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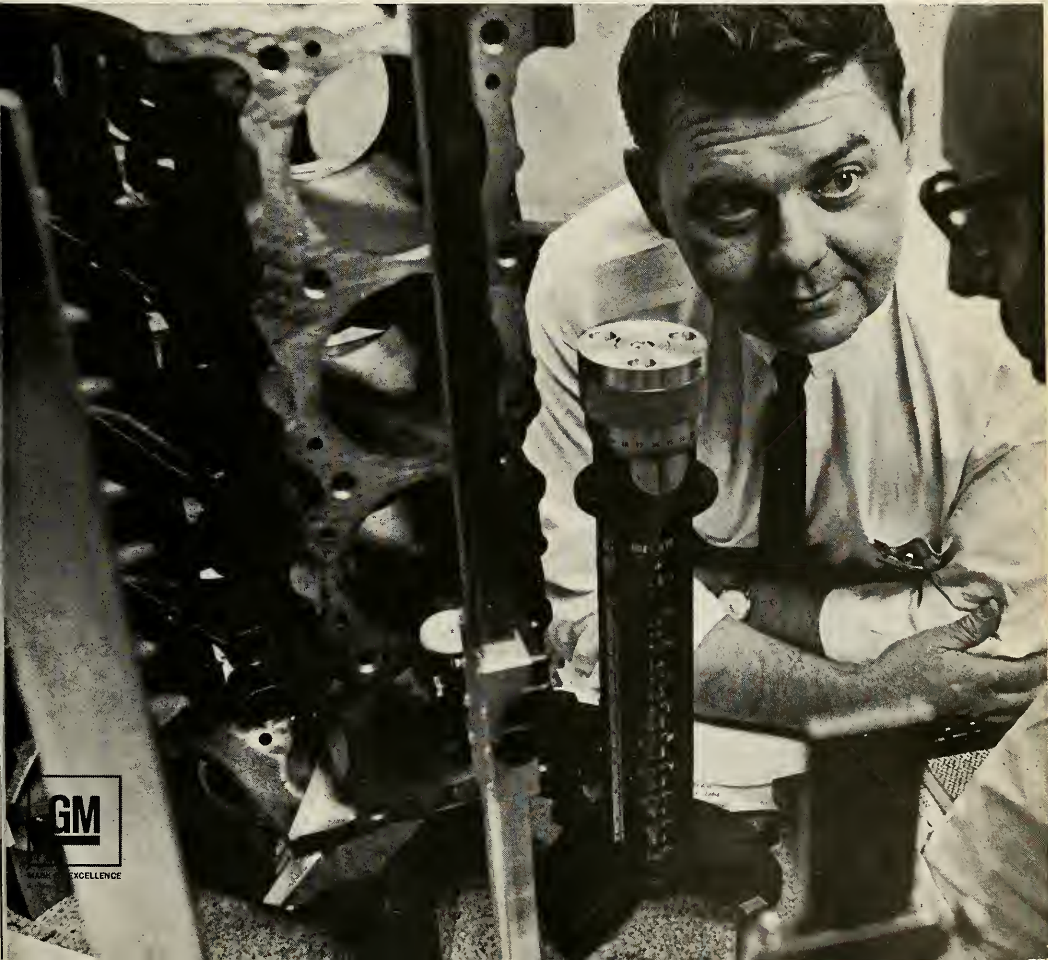

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THE AUTHORS

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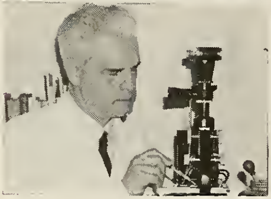
Eric V. Gravé

Jerome Lettvin is Professor of Communications Physiology and a Lecturer in the Department of Humanities at Massachusetts Institute of Technology. The American Museum of Natural History has chosen Dr. Lettvin to deliver its annual series of “Man and Nature” lectures, which will be given in March, 1968. The author of “You Can't Even Step in the Same River Once” approaches his treatment of hippie culture with an extensive background in psychiatry, obtained since his graduation from the University of Illinois Medical School in 1943. Living in Cambridge, Mass., has provided Dr. Lettvin with the opportunity to observe one of the country's thriving hippie communities.

Between 1961 and 1966, Valerius Geist spent a total of forty-three months in the home ranges of the Dall's, Stone's, and bighorn sheep. At one point, he remained afield for twenty consecutive months in the Cassiar Mountains of northern British Columbia.

During this lengthy period of field research, the young zoologist succeeded in collecting a series of unique observations of these sheep. He was equally successful in befriending them, for after being fed salt and cookies, the sheep began to follow Dr. Geist about the mountain. The conclusions of his intensive study and many of the behavioral observations made during this time are recorded in his article, “A Consequence of Togetherness.” Dr. Geist, who obtained his Ph.D. from the University of British Columbia in 1966, has also done field work on the behavior of moose and goats. His findings have appeared in several scientific journals. The author is now involved in research at the Max Planck Institute in West Germany.

While painting owls in the confines of a museum, Faith Medlin became curious about the varied ways in which other artists in other cultures had depicted this wide-eyed creature. This curiosity, she says, “led to bird-watching in museums and libraries all along the northeast coast, and to correspondence with sources throughout the world.” The outcome of this indoor bird-watching w Mrs. Medlin's book, *Centuries Owls*, published by Silvermine Pu lishers. This month's “The Owl a the Artist” is taken from that boo Mrs. Medlin graduated from the U versity of Minnesota with majors journalism and fine arts. She h worked as an artist and writer in a vertising agencies, and has travel widely in Europe, Canada, the Unit States, and in the Caribbean. M Medlin now resides in Rowayto Connecticut.

“No One Knows Where the Turt Go” is the second article of a tw part series written by Archie Ca Dr. Carr, famous for his work w the green sea turtle, is a Gradu Research Professor of Zoology at t University of Florida and a Resear Associate of The American Museu Both articles in his current series a taken from his newest book, *So Exc lent a Fishe*, published by the Natu History Press.

Gerald A. Jayne, nature phot rapher and author of “On the Sna River Lavas,” has observed that o of the major charms of the lava be of the western United States is t they have been little changed by m Thankfully, the beds cannot profitably grazed, mined, or ti bered, and thus, future exploitati seems unlikely. In most cases th the only influence on the lavas si their formation has been the natu processes of erosion and plant s cession, as described and pho graphed by the author. Mr. Jay an ardent naturalist, works as a co puter programmer in Idaho.

Eric V. Gravé, author of “Ch chaos,” is a staff member at the L oratory for Cell Physiology Columbia University, and supervi medical photography at the Colu bia Presbyterian Medical Center. specializes in photography thro a microscope, a painstaking busin that may require hours of effort order to capture a desired seque of events in the life of a microsco creature. Mr. Gravé's photomic graphs have appeared in encyc pedias, biology textbooks, and i number of nature magazines in t country and in Europe.

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You Can't Even Ste
in the Same River Once

by Jerome Lettvi

An impassioned essay on the morality a
philosophy of hippies (the pastor
fantasy/noble savage complex) and the lamentab
physiology of the psychedelic tr

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After several attempts to write this article, I have decided that, since a good natural history of hippies is easily accessible, as in *Time*, *Ramparts*, and a variety of other such journals, I will address myself to the moral questions that the hippie movement has raised. This is an odd subject for a magazine devoted to nearly unprejudiced descriptions. Since it requires more opinion than fact, it reveals more about the author than the material he handles. What is worse, it imports value judgments that, as everyone knows, have no place in science—even in footnotes. I say this now so that none of the readers will think me so disingenuous as to try to palm off personal biases as laws of nature. Clearly my reatment of this topic is that of a middle-aged man who can't quite get with it.

Let us make a cut between hippies nd eccentrics. How are they similar? There is a fine disregard of conven-ional conventions. How are they dif-erent? The eccentric is concerned with the world in some form or an-other; the hippie is concerned mainly with himself.

This is a strong distinction that I make for the Cambridge scene where work and teach. It may not be true lsewhere. At first glance you cannot distinguish one from the other in Harvard Square. But the eccentrics ttend a few pot parties, try LSD once nd then stay away from it, and are mmersed in one or another branch f learning or art. Hippies attend few iscussions, colloquiums, or exhibits, et hung up on psychedelic drugs, nd dabble only with what evokes an mmediate, capricious response. Eccentrics may turn hippie; so far I now of no hippies turned eccentric.

The greatest immediate distinction es in the language used. A predoctoral candidate in philosophy, an eccentric last year, turned hippie and as left Harvard. When I spoke to im a few weeks ago, he talked in this ein: "Like, man, there's nothing here to keep me; like, you know, the stuff doesn't turn me on anymore." He was not merely acting, for I heard him later talking to some of his friends this way. The language does not convey meaning so much as mood (like bird calls) and changes from month to month in its accepted vocabulary.

At present, the common cause between eccentric and hippie is proper hatred of the way things are, and the common inclination is for personal justice. But the first tries to understand what, say, our government is attempting; the other doesn't even try. Both fly the same banner, "Make love—not war," but the eccentric's plea will carry a footnote, "Won't you try to explain?"

I have met a variety of hippies around Cambridge, yet cannot claim to know them at all well. They are, for the most part, amiable souls, and I feel comfortable among them. For example, I like going to be-ins and love-ins. Someone hands me a lollipop with *hoc est corpus meum*. Girls dress at their most sensuous, offering the erotic but not as ritual. They are miniskirted to a fault; their men are cunningly bearded. Groups form spontaneously, break up easily, reform again. People do not polymerize one to the next as at other parties, instead the whole be-in flows through itself like water. "Pure being," no "becoming": the pastoral ideal, the splendid innocence. So must have been the Bacchanalia: but now not wine, rather pot. Surrounded by soft walls, a flute, a drum, and a guitar weave reminiscence in endless filigree; the walls sway with closed eyes.

The hippies I know act a Christian ideal. They are generous and disinterestedly kind if you can get their attention; they will give food, clothing, anything that is needed if they have it. They are not curious where one comes from, who one is. Among them the lame, the disfigured, the mental defective can finally be at home. It is a bittersweet joy to see the self-consciousness of a cripple dissolve among young people who make no morbid inquiry, even tacitly with a glance. That is why many Negroes come from Roxbury to Harvard Square; from Harlem to the Village. Where liberals carefully won't notice color, hippies simply don't. The liberal is nervously pleased to see a Negro boy dancing with a white girl; the hippie doesn't even see. It is much better to be a part of than to be merely accepted. In this way the hippies are admirable.

They are detested by the universal middle class because they seem to have all the revolting appeal of what Hollywood thinks early Christian sects were like. (Love your immediate neighbor in the immediate; seek the Godhead within your own spirit; leave the world to the hands of the demiurges who have made it as it is; there's a better universe next door.) A man involved somehow in a ballet with a questionable corps of government or industry reserves his hatred, not so much for the panning critic or the impresario of another shoddy troupe, but for that monster who will not even watch the performance. The average Californian is enraged by the Haight-Ashbury people, and so he gives body English to the lions that enter the arena on the late, late show.

The hippies I know are also anarchist, but not ideological. They are what Kropotkin was writing about, rather than what reads him. They do not view society and the state as evil; on the contrary, they will not even conceive of these institutions in the abstract. Oppression is a personal thing: Mr. A is stomping on Mr. B. They have cultivated an ignorance of formal politics to the point where they reflexly blank out any reference to it. By stubbornly reducing the action to what one man does to another, they bring morals to bear on public issues. In this way they serve as a source of public conscience.

Hippies treat the world of artifacts as we are told primitive farmers may have treated the land—as a miraculous and dangerous plenum yielding not only good things like electric guitars but bad things like guns. Cities are a natural resource but are booby-trapped by the fuzz.

The hippie is non-intellectual. I do not mean this pejoratively, in the sense that I would say the American Legion is anti-intellectual: rather, he has developed a lack of curiosity about the world around him, how it came to be the way it is, or what it is going to be. A hippie cosmogony is unthinkable. He doesn't flame to illumine the world, instead he is turned on passively, like a night-light. He doesn't examine by reason but palps

---

* *The title is from G. de Santillana, uoted in Siegboldt's* Fragmente der Nachechender. *The same words are attributed Cratylus, the philosopher who communited by crooking his fifth finger. According to Burnet, it was Cratylus' comment on hearing Heraclitus' famous aphorism: You step and do not step in the same river vice; you are and are not.*"

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with his guts, and this condition is not forced on him, he has chosen it freely. It is a deliberate turn to one concept of the noble savage.

There are many subgroups of hippies. The diggers are the socialist or condominial type; they live in bunches in large houses, sometimes on farms. Teeny-boppers are astonishingly dedicated sensualists among teen-aged girls. There is a kind of intellectual hippie, who, like the doctor in Chekhov's *Ward No. 6*, wills his own down-going. There is also the rat, or reconstructed hood, from Hell's Angels in California or the Devils Disciples in Massachusetts, who becomes a kind of proletarian Batman. A fair number are non-psychedelic hippies who achieve a simple and direct amentia without the help of drugs. Social scientists can supply a much longer list; so can my daughter and her friends. It is unnecessary.

The hippies of my acquaintance would be more interesting to read about than to know, like those early African church fathers who experimented in asceticism. I am disturbed at relegating to them, as a class, the garbageman's job of being a social conscience. For when I consider those I know, one at a time, the melancholy notion is forced on me that, for each, their actions and inactions do not arise from reason or passion. The hippie comes to his world view by default and sustains it by deprivation; so that his political virtue is like the chastity of an anchorite. He is not so much bohemian as conservative. and he is as dull as any exurbanite but in a different way. At best he has substituted his navel for TV; at worst he has limited his freedom of action more drastically than any bourgeois. He differs little from his counterparts in past decades but is only more public now.

By simplifying politics into terms of man-to-man relations, hippies (and their progenitors, the beatniks) clarify the dreadful nature of most political acts. But this candor can come about in several very different ways. The way of Bertrand Russell or Linus Pauling is through intellect guided by incorrigible moral principles. Another way is through frustrated or undeveloped reason, as with mental defectives or children who expose by unintended caricature what perverseness underlies our conduct. It would almost seem that to attain a childlike view that sees through the Emperor's

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w clothes, one must choose between
rring or spoiling one's faculties.
ppies have taken the latter course.
Most of the radicals who grew up
the thirties would, I think, sympa-
ze with the anarcho-socialist char-
er of the hippie movement. They
ve lost the enemy capitalist or, at
st, cannot distinguish him so clear-
nymore, even by corporate names,
d are faced only by themselves,
wn to an unenviable maturity and
ssively enduring an ineffably cor-
t society. But the full shame of
ir demoralization does not hit
m until someone like a hippie asks,
oesn't it hurt when you can look a
zi in the eye and say, 'Brother!
y!' " It then seems spiteful, almost
udian, to examine this much need-
conscience and find that it, too, is
k. Yet I assert that the hippie
vement is dismal and dangerous
l offsets its political value by the
sonal harm that it does. I want
discuss the causes and nature of
s movement insofar as it involves
dents, for hippies congregate
und universities or places where
ists live, and their ranks are
lled in great part by students.
s to the causes: It is unnecessary
list the usual global sources of
pair that confront today's adoles-
ts. There is the war in Vietnam,
inequities that are visited on Ne-
es, the more widespread injustice
our own government seems to
nsor abroad as at home. While
se inform the disquiet of the stu-
t in high school and college, they
not the efficient causes of wide-
ead retreat to the inner life as op-
ed to revolution. Instead, two
e intimate influences are the fol-
ing: The schools have become
inesses, rather than a refuge from
world; and ideas, as ideals, have
ome devalued. Let me illustrate.
ere, formerly, a child who be-
e interested in, say, mathematics,
ld pursue this discipline in its
right as an amusement, as an
pe from parts of the world, and
private matter, he now must treat
a basis for long-range competi-
, and to achieve excellence, he
s not scale the heights alone but
the backs of his competitors all
way. His reward—to listen to his
ructors—is, not the joy of under-
ding, but a secure position at the
ense of his friends. This is the ter-
burgherizing we have done in
cation under the guise of bring-

So you have some extra money to invest—

Maybe $500 . . . or $5,000 . . . or $500,000. The dollar amount simply doesn't matter.

What *does* matter is what should you do with it now! Just how should you invest it?

And that's where our Research Division comes in.

All you have to do is fill out the rest of this form, return it, and then receive the very best suggestions our Research Division can come up with in line with *your* funds, *your* objectives.

There isn't any charge. We don't feel that you're obligated in any way.

Now then, got a pen or pencil?

- -

Yes, I do have some extra money to invest—approximately $________________in fact.

I would like to see what your Research Division would suggest, remembering that my objective is the one I have checked below:

☐ I am most interested in securities that provide relative safety of capital coupled with a liberal income return.

☐ I can afford to assume a little more risk and am interested in common stocks that are attractive for income and capital appreciation. I would like to realize a current return of about______%.

☐ I can afford more risk and am primarily interested in good *quality* growth stocks that have the potential of increasing in value over the years.

☐ I am interested in attractive speculations and can afford to assume the risks involved.

I understand there is no charge for this service, and that you will mail your answers—in complete confidence and without any obligation of any kind—to me:

NAME____________________________________
AH-16
STREET__________________________________
CITY________________STATE_______ZIP_______
YOUR PHONE NO.__________________________

All filled out? Then for the very best help we can give you, simply put this in an envelope addressed direct to Harold F. Wiley, Manager, Portfolio Analysis Department.

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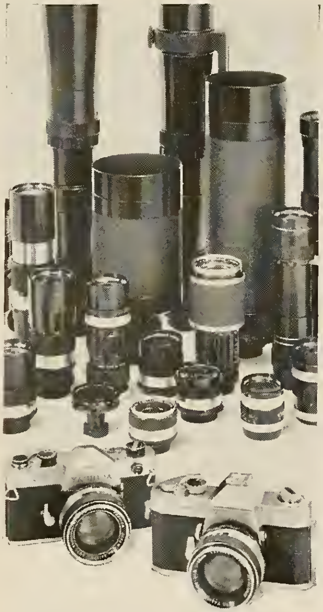

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ing the system up to date. It is quite true, of course, that some of the very best students survive, for their passion for ideas can surmount almost any obstacle. But others, put in this kind of competition, lose out. Look at the multiple-track systems in your own local high schools, those saloons of no further chance. There is no room there for the cheerfully eccentric scholar.

What are the rewards we hold out to the lucky one who gets to college? Looking at the ends to which we press learning, can you say that these are desirable? The youth casts about him and sees no Leonardo or Galileo or Bach but, God have mercy on us, you and me: the most probable of his destinies, gulls of our own cheats, liquidating our principles for self-interest; flat-footed narcissists, glued to the idiot box as to a mirror and dreaming only of the likely according to the rules. *Cocio, ergo sum.* I am a broker, therefore I am. As the Fugs—a minstrel group—put it so well: Monday, nothing; Tuesday, nothing; learning, nothing; teaching, nothing. It is not the poignancy of a despair that implies a lost hope—it is the nonbeing of Dostoevsky after the firing squad; death, frustrated like a sneeze, dribbled out by installments. Where ideally the universities ought to be ivory towers in which to dream of remade worlds, now they are, as perhaps they always were, shops for the training of apprentice nebbishes to fit with the existing system. What is there left to do but to escape inward or to mature?

Then, too, we foul even the wellsprings of spirit by devaluing possible goals. For to what end does one become a good musician or mathematician? If we say it is not personal glory or the tax-free money of a prize, what is left? Is it that wonderful, that transcendental kick you get out of doing something well? Ah, that kick! That revelation! How very like an orgasm it is. Can't we really bring mind to the same healthy and open status that sex now enjoys, where we have ceased tending in tortured secret our hidden needs and instead do it, and do it again, for health? Come, it is not what you do, it is the kick you get out of doing it. If you cannot rise to your standards, lower them for yourself. And you can accomplish this by simple training. The graduate of Wellesley, who, some three years and a baby after gradua-

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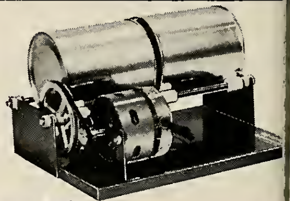

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ın, writhes with ecstasy before a
: of pop art, did not inherit that
ent; rather she has spent four
rd years learning to delude her-
f, and having interned and ex-
ned in the discipline, can now turn
in an inexhaustible esthetomania,
ing from climax to climax, like a
dillac on a winding road, tilting
ıoothly with the cant and inducing
ly the vaguest emotion-sickness in
r passengers. But not one of us who
ıvels with her can cast the first
ıne, for we already cast both a
ıg time ago. Now let us go back-
ge and talk, not gushing-like, but
ılly talk to an artist.

Sir, why did you do it at all?

*When you do something like this,
nplete it, you get a feeling—it's like
other feeling in the world. There
s the stuff to be put together, and
ly one person could have done it—
. It was I who was chosen by the
ls to produce this masterpiece, I
o can only stand here humbly,
owing myself to be the chosen in-
ument through which it created it-
f. Look how beautiful it is.*

But sir, why did you do it?

*It had to be done. It was needed.
had to be there.*

What did you get out of it?

*I can't describe it. It's a feeling . . .
completeness for this moment? . . .
sudden new vision? . . . I don't
ow; it's just a feeling.*

And so the youth is brought to
pect that it is not the production
t is important but a complex sen-
ent occasioned in the producer—
us call it a kick. It is the only an-
er we can get if we insist on look-
for motives instead of seeing the
. This is how Freud has affected
culture. The game then naturally
omes how to get one's kicks more
ciently, and it is then that you will
t training to become an interior
orator or a nymphomaniac.

Ve have done our best to make
ps of schools and to make ignoble
goals of art and science. At this
nt Leary comes, Ginsberg comes,
hole raft of psychogogues, and in-
culate as any artist, unassuming
any mathematician, nobly savage
any Chingachgook, suffused with
e, inflamed with gentleness, they
y their seductive medley from
ıst. Is it the kick you want without
ting anyone else? Is it that mo-
ıt of truth when you cry "Let time
now. This is it. I am as a God"?
n shed this senescent world where

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—This Year—

Reservations for 1967 have closed, and many tours have been completed. Enthusiastic "veterans" will testify to a fine spring season in North America, the Mediterranean (where the famous Coto Doñana in Spain shared honors with the Camargue, Corsica and Greece), Great Britain, Scandinavia and Iceland.

HAWAII: Our Xmas party this year is at the Volcano House, Kilauea Crater, followed by a 10-day bird-and-scenery tour of the islands.

–Program for 1968–

We cover the wildlife of the world on a 3-year cycle, visiting some areas annually. Here is the expected program for 1968. North American tours are 2 weeks each, overseas 3 weeks, and are set up in chains of 3 or 4 trips, in case you wish to stay longer.

NORTH AMERICA: Florida, Jan. 27. Texas-Northeast Mexico, Mar. 23. S.E. Arizona, May 4. Alaska in three 2-week stages beginning June 1, expanding the highly successful series of 1967 trips.

MIDDLE AMERICA (2 weeks each): Yucatan, Feb. 10. Mexico East Coast, Feb. 24. Mexico West Coast, Mar. 9. Northwest Mexico, May 18. Chiapas, July 13. Yucatan, July 27. Guatemala-Honduras, Aug. 10. Costa Rica-Panama, Aug. 24.

SOUTH AMERICA (3 wks. each): Colombia (world's top bird country, which we visit twice yearly), Feb. 10 and Aug. 10; Guianas-Venezuela, Mar. 2. And a series of tours around the continent beginning with Ecuador-Galapagos, in the Fall of 1969.

EUROPE: The Europe program makes possible many combinations: Greece migration, Apr. 20. South Europe, May 11. Mediterranean, May 11. Norway, June 1 & June 23. Britain, June 1. Balkans, June 1. Iceland, June 22. Russia, June 22.

AFRICA: South Africa, July 20; Central Africa & Madagascar, Aug. 10; East Africa, Aug. 31.

ASIA: Japan, May 18. Next coverage of other parts of Asia early in 1969: Philippines; Thailand-Malaysia; India-Ceylon; Himalayas.

— SOUTH PACIFIC —

Feature of the year; many think it the greatest trip of all. Six units; combine as you like:

MELANESIA: Fiji, New Hebrides, New Caledonia, Solomons and 2 weeks in New Guinea. Four weeks in all, beginning Sept. 9.

AUSTRALIA WEST: From Perth around the coast to Darwin, plus the deserts at Alice Springs and western Queensland. Oct. 5, 3 wks.

AUSTRALIA EAST: The Great Barrier Reef, Sydney & environs, Adelaide and the Murray River valley, Melbourne and Tasmania. Three weeks beginning Oct. 26.

NEW ZEALAND: Comprehensive 3-week coverage of both islands, working south with the spring. Geysers, glow-worm caves, majestic Mt. Cook and Milford Sound. Nov. 16.

N.Z. BOTANY: Two weeks up the west coast in a land of strange plant life and magnificent glaciers. December 7.

WORLD CRUISE: Around the world in Southern Hemisphere: Easter, Pitcairn, the great bird islands and Antarctica. Winter 1969-70.

Come along! . . . Intimate, private groups, expert leadership. We seek out back-country routes, try for an experience-in-depth of the natural scene and the people. (Not recommended if you're strong for night life.)

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discovery has all the abandon of a forced move in chess; discard this world where any good for yourself obliges an evil to another. Do it yourself. Make your own world. For the only true creator is the solipsist; no space but his sensorium; no time but his will.

This is the seduction that was offered to Faust. It is also the hell he gets in consequence and the greatest punishment there is—that he does not suffer in it. This is the shopworn temptation remaindered to the students. Observe, says Leary, the ways of your fellow who burrows for gold and never gets it. Were he not happier in rejoicing over angleworms? And to what goal the gold? I mean, like so what! You dig? Burrow to the inner chamber, the holy of holies, and you find a privy.

Leary is right, and I am right. But the problem is not, it cannot be, how does one get one's kicks and stay a decent man? For then the answer is Leary's—withdraw, drop out, let the world only occasion, but never cause, your perceptions.

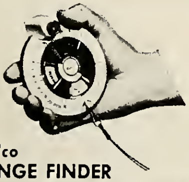
The know-nothing argument a hippie: Our troubles are seen spring from too much play of the i tellect, which suppresses those natur instincts that fit us to each other ar to our environments. Among such i stincts are humaneness, pleasure small things, introspective joy, etc. in a word, the whole, fake pasto

"At this point Leary comes, Ginsberg comes, a whole raft psychogogues, and inarticulate as any artist, unassuming any mathematician, nobly savage as any Chingachgook, su fused with love, inflamed with gentleness, they play the seductive medley from Faust.*"*

fantasy/noble savage complex. O as little children shall ye enter heav To attain a state of grace you ne to quiet your intellect, suspend yo judgment, open up your guts, and the sun shine in. But now comple ties intrude, distracting the sp from unendurable turn-ons ind nitely prolonged, deranging the c with nightmares of reason. The h pies take LSD to avoid them.

Leaving drugs aside for the r ment, let us examine this temptat further—the "turn on, tune in, dr out." Suppose I were to come to y a smiler with a knife, and remark: the world too much with you, friend? Come, let me lift the eye so, and with a simple pass of the sc pel I will now abolish all caring. course you will still be able to add a subtract; of course you will still able to make out, indeed better th ever; you will have every faculty l but you will stop caring." Why wo you resist? I am sure I would; me, caring and planning are in

Haverhill's Importorium



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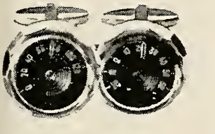

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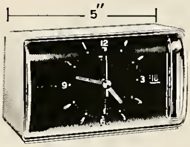

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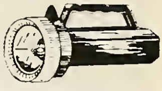

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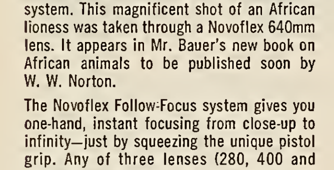

solubly connected. Furthermore, I want to care about the world: that part of me is human that loses bits of itself when anyone else dies, that suffers if someone else is hurt, that remembers past pains of others and plans to prevent pain occurring to them again. Without it I become a house pet, docked in spirit.

But it really doesn't matter if such a mind-washing is done by a drug, a knife, or the implacable will. Any way of dissolving the tattletale gray is as good as another. A prolonged indifference to the complex and abominable world can only become self-reinforcing. The same loss of degrees of freedom in action that we see occurring in the conformist businessman—hemmed into his own suburb and meeting on the street only himself walking the other way, held to the tracks that guide him from office to office party to home to golf links—in a word, that same poverty of soul we recoil from in Babbitt, afflicts the hippie also. The only difference is in the setting and the language; the play is the same. By deliberately excluding himself from the general scene, by turning his attentions inward for the most part, by attending only to the immediate, the hippie is as constrained as the square and becomes the right wing of the way out.

At this point the hippie objects. It is not, he says, as if I were blanking my mind as the alcoholics do. Rather I have turned the full power of inquiry onto myself, searching the utmost reaches of that unknown region. Deprived of outer freedom, I have found inner freedom. If I can stand revealed to myself, reflecting, as I do, all the world in microcosm, then I shall have achieved that understanding that you can only fumble with, you who turn your attention to those inaccessible others. Having said which, he goes back to the lotus position, adjusts the focus, the horizontal lock, and the contrast on his umbilicus, and contemplates deep Oriental thoughts. Zen onanism.

But it is not obvious that introspection reveals anything new, or even reorganizes one's view of the universe, except to silver the window through which he looks. Certainly, in the event, the man who is preoccupied with himself seems to do very little of interest for any one else—after all, why should he? Nor does he understand what is given him by

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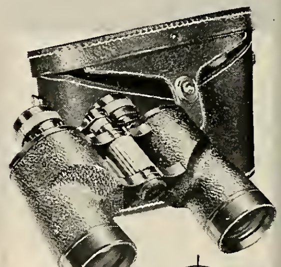

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e world—what need has he for such istractions? While such a move to e inner search is not to be condemned by any first principles, it rops the searcher from that in which e are all engaged. The disengagement is similar to the non-involvement of spectators at a murder. rdinarily, only a few specially ifted people can maintain this posure adopted from some mysterious ast. The settings have to be propitious—an air-conditioned desert like os Angeles two decades ago—and oney must be easy to get so that e need not want while not willing.

Besides the spread of the wasteland d the generalized affluence, what as changed the ability of a student drop out in the most general sense as been the advent of psychedelic rugs. The danger from these toxins not what the medical profession aims. The chances of going mad or etting permanent brain damage are rtainly there, but then what adven- re is not accompanied by danger? fair number of scuba divers, moun- in climbers, and astronauts are lled off by what they do, and no- dy makes much fuss. Whoever eaks out hazards a bad trip. So hat? Pointing out such perils can ly whet one's appetite if one is ung and ripe for any new experi- ce. And the experience itself, as is limned, is certainly attractive. fore we discuss it, however, let us te some difference between the ndling of pot, LSD, mescaline, MT, STP, etc., and the usual diffu- on of narcotics. Heroin and other ium derivatives are sold by *pushers* prices kept artificially high by ofiteers in the syndicate and sub- asury. Thus, nobody can afford to ss them around as a gesture of endship. The psychedelic com- unds are distributed by *dealers* at tes kept cheap by the ease of manu- ture and the speed with which new isons appear (for example, the run catnip in Los Angeles a few years o, and the oregano party in Denver g before anybody thought of rning glory or bananas). One can ord to keep whole parties of ends sent up on precious little. The nerosity in dealing can overwhelm u. Now pot comes dipped in LSD a more interesting trip, and it's t so that one can't be guaranteed a re reefer in Harvard Square, what h the biochemistry students and ir damned philanthropy. Yet even

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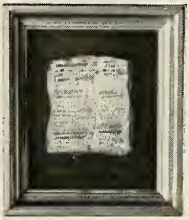

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if horse (heroin) were as cheap a
pot, there is some reason to suppos
that pot and LSD would stay pr
ferred. For horse really only affec
mood, and alcohol takes the edge o
the ambient, but the psychedelic
provide a show.

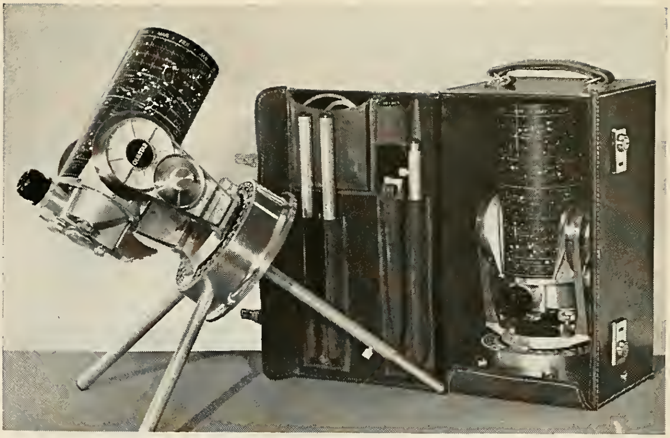
Briefly, what a trip gives is a con
tinuously changing distortion of a
perception and perception. Not onl
do sensed forms alter in appearance
they alter as well in the significanc
of their parts. Roughly, it is as i
metaphors and other figures of speec
directly apply to the observed world
So, for instance, a friend in the roon
becomes a demon, or is both ther
and not there at the same time, o
becomes part of you. The descriptio
of such experiences is somewhat diff
cult to put in words because the ap
paratus of language is so geared t
"usual" meanings that strong reo
ganization of connotation cannot b
expressed. At the same time tha
whatever is out there changes inde
scribably, so too does whatever i
inside, so that the view you have o
yourself alters steadily also. Thus
trip is not a disorder or expansion o
consciousness (in the sense that to b
conscious implies you can bear wi
ness to others, literally togethe
knowing), but an aberration o
perception and judgment. Such a
aberration clearly cannot be pro
duced by physically distorting de
vices such as funny mirrors at th
state fair. There are two major con
sequences to such an experience
First, the psychological processes tha
remain invisible because the worl
works as expected, now come int
view through being unreliable.
comparison may be had here with th
blind spots of the eye (there ar
many more than you imagine), whic
remain ordinarily invisible becaus
they move with the eye. Odd way
have to be devised to bring them t
direct perception as lacunae, rathe
than discovering them through in
ference, such as the vanishing of
properly held black dot. Second, th
miraculous nature of perception i
self offers itself for wonder. The colo
red, the sound of the word *red*, th
concept of redness and a red obje
become confused in the interestin
way that some philosophers claim t
suspect we have always used.

What could be more delightfu
than a television set that could shuff
forms and qualities in this way at th
turn of a knob? But the nearest w

n come to it is in trying to distort r unaided vision, for electronics e not yet so sophisticated. And so use stroboscopic lighting, super- sition of projection images on real ings, etc.; in a word, all the kitschy d campy and pop-arty techniques at are sold by the various psyche- lic shops. Anyone who has not ken a trip cannot see what is eant; anyone who has taken a trip n reminisce; anyone who is taking trip applies his distortion to this stortion in the hope that he can get stortion squared.

Now all this kinked viewing is not ad thing in itself. Certainly none t the most rigid of people would sist on staying jailed inside his own ame of reference and spit at the free irit that took off straight up. If this re all, I think that I would be out d up there too. But now we must, happily, examine the true dangers, which I will mention only two.

First, there is a reasonable ques- n one might ask about the length action of a drug and the side ects. Let us forget all the jazz out broken chromosomes or land- ; in the state hospital. Instead let ue ourselves in by looking at other ceptable" drugs. Suppose you take ast-acting barbiturate, seconal, to a night's sleep, on the premise t you wake up refreshed, all your ulties with you. If someone ex- ines your performance, however, can see traces of derangement for out 36 hours. If you take seconal htly, you will find a cumulative ect after a few days. Thus drug ion can sometimes outlast what the rmacologist tells you is the time drug stays in your system. But re is never a very great protrac- n of effect beyond presence with ect to compounds that affect nervous system unless a serious nge has been wrought. So, for ex- ple, after a single dose of wood hol, a man can go blind or crazy become paralyzed. Now the sad g about LSD and mescaline and T, as opposed to pot, is that psy- logical effects outlast by weeks, sometimes months, the disap- rance of the drug from the sys- . I have known some scholars , after taking a single dose of ning glory seed concoction and ing a wild trip lasting for a day two, were literally unable to get k to serious work for about three ths, although they functioned



THE QUESTAR TELESCOPE IS A VALUABLE TEACHING TOOL

It is indeed gratifying that every month more and more elementary schools, high schools, and colleges are buying Questars. Many educators have realized that it isn't always necessary to spend hard-won tax dollars to build an observatory with a large, expensive telescope in order to provide an astronomy course. If you have $10,000 to spend, for example, 10 Questars would furnish a whole class in astronomy or general science with superfine telescopes, with the added advantage of being able to use them in the daytime for safe solar work and nature study. Moreover, today's fine plate-glass windows permit flawless views of the heavens, except near the zenith and for this a skylight might be utilized. A south-facing window will permit following of the moon and many other important sky objects.

Recently we received a letter from Mr. Curtis W. Gable, an eighth-grade science teacher who decided to experiment with his own Questar in his classroom. He used it for teaching the types of astronomical instruments and for studying the sun with Questar's safe, external solar filter.

The students responded with such delight and exuberance that a regular program involving other science teachers and approximately 200 students was developed. The course helped to identify several students who proved to be capable of high-quality work in astronomy.

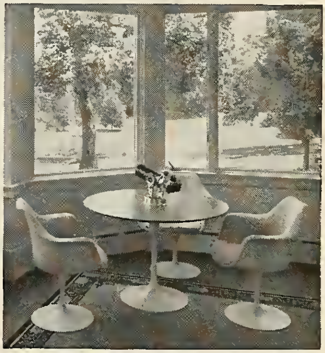
This student interest led next to the forming of an astronomy club which met several times a month. Its wide range of activities included a discussion of current events in astronomy, a presentation of special reports on astronomical subjects, the showing of 35-mm. slides, practice in the use of the telescope, and special observation sessions. While club members brought in their own telescopes, the Questar, because of its being so easily set up as an equatorial, and because of its clock drive and setting circles, was the most useful for teaching.

We were particularly interested in the instruction course each student was put through before he was permitted to use the instrument. First he was given some typed pages of information to read, which included a numbered diagram of the Questar and a correspondingly numbered list naming and describing the parts of the telescope. Another page explained the optical system, comparing it with conventional telescopes. There were directions for locating a celestial object, and, finally, a list of club rules.

Group instruction in the handling of the Questar was followed by the individual guidance of each member. He was given several "dry runs" in its use and was permitted to touch only the control knobs. Great emphasis was put upon keeping fingers off the optical surfaces. The safety factor of the sun filter was particularly stressed, and any violation of the safety rules resulted in dismissal of the club member. Teaching was thorough, leaving nothing to chance. Each club member had to demonstrate that he had mastered the technical information and had skill in its use.

Mr. Gable says the results were well worth the precautions; that with proper instruction, and strict discipline on the part of the owner or teacher, groups of children can use the Questar without damage to it or themselves.

Actually, Questar is a rugged little giant of a telescope, so well built that it can stand considerable abuse. Some have been out in the schools now for nearly ten years, and occasionally one comes back for cleaning and inspection. We seldom find anything seriously wrong. Even one or two that had been dropped sustained only minor damage. The drives will show wear, just like the brakes on your car, in proportion to their hours of use, but this is a simple replacement for which our charge is five dollars for each drive. Furthermore, we have a special low-rate service charge for all educational institutions, which the schools have found most reasonable.



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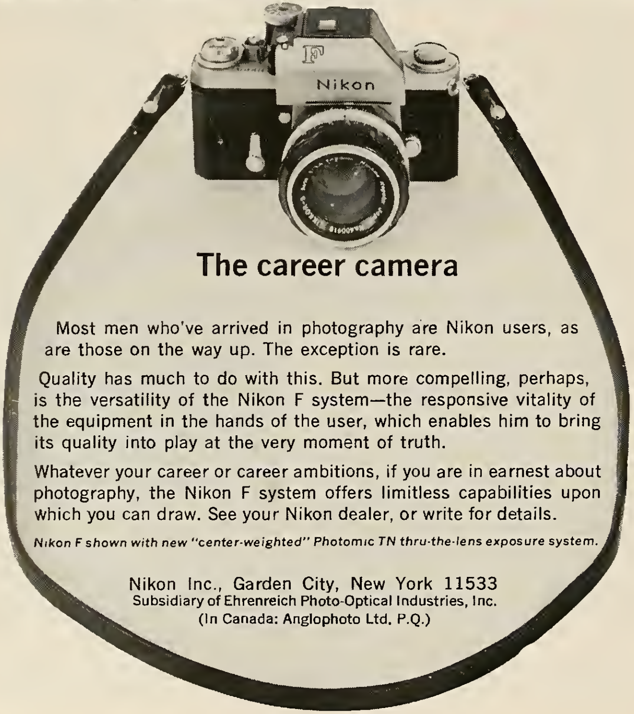

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pretty well socially within the wee Their complaint was that, with r spect to critical arguments, it was if they had been clubbed with a du mallet. Students at MIT who ha taken only one dose of LSD ha reported return trips to me, and, reviewing their school performanc I could see a significant change f quite a while after. I except tho who went psychotic after one do and speak only of those who did n show any "bad" effects afterward.

The blunt fact is this: If someo came to a neurologist complaining a disordered perception of the sc had under LSD, the most probab diagnosis would be an affection of t temporal lobe of the brain, or t temporoparietal region. Further, the man said it was episodic (retu trips), occurring for no obvio reason, the neurologist would su pect a focal lesion in that part of t brain. Here, where we are assur that the drug has been excreted, b effects similar to those of focal lesio persist, what is a neurologist think? I shall not pursue this matt further, but instead only remark th disorders in judgment and percepti last for a long time after a dose psychedelic drugs. Furthermore, th disorder may be such that the m cannot judge he is disordered (li the drunk who insists that he is sob enough to drive home). And th brings us to the second danger, t psychological one. It is the more i portant.

Just suppose that you have be exposed to an intoxicant that la for several days. One of the curio facts about our nature is that we b come accommodated to a recent no and often act to protract it. We ha those psychotics in a hospital whom the doctor believes that th may have recovered but do not kn it yet. These are the patients who r cover miraculously after a sing shock treatment, for the induced a nesia of shock lets the patient co out of his stupor remembering t more remote parts of his past fir the more recent ones returning or later; so he can, as it were, place h remoter self in the same specio present as the way he was yesterd Those of us who have gotten que fears or odd reactions to particul events know how rapidly an unr sonable habit takes over. Like dev oping an aversion to shrimp aft eating a spoiled one and getting ve

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sick. In exactly this way, a man, exposed to protracted change in judgment comes to prefer it, or tend to it, like the sodden alcoholics one reads about or knows, or like epileptics who relish their auras with joyful fear (see Dostoevsky). Especially if one is self-conscious or hates the world around him, is afflicted, rather than challenged, by it, he much prefers, and who can blame him, the less distinct form of his hostile surround. What recommends alcohol or pot as an intoxicant is that within a day after the binge you can make a judgment comparing how you were the day before yesterday with how you felt yesterday. On this basis you can either decide to have it again or not. But the choice is made with your full faculties. In the case of LSD or DMT or some of the more protracted and frightening new compounds, you do not have your judgments returned so rapidly that you can compare validly the imperfect with the pluperfect view.

Thus it is that students, already somewhat pressed, already subject to the far less than idealistic tenor of our schools and the nature of our society, on taking such compounds can become easily recruited to the hippies. and, turning on, drop out.

It is this feature that makes the hippie movements (as contrasted with mere eccentricity) dangerous. Hippies, in one form or another, have always been with us; they are, in a way, appealing, for they reflect the beachcomber, the people of Tortilla Flats, and all the other romantic pastoral types we all dream of being for a while. But they have never before had so strong a recruitment of the young as now when they have the judgment-dissolving drugs, the psychedelics, coupled with the extraordinary rearward force of a diseased society. I admit that it is a moral judgment on my part to say that it is a better thing to confront the world, terrible as it is, than to retreat from it to limbo. It is a matter of free choice that a man should decide between lethe and hell. But the choice should be made on the basis of fully informed comparison, and I claim the drugs to be vicious because their effects last so long as to bias that choice. It is equivalent to asking a lobotomized man, or a patient after prolonged psychotherapy, aren't you happier now? I hold stacking the cards to be unfair and immoral.

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A Naturalist at Large

Skin-in, skin-out

by Marston Bates

Each semester I arrange a seminar of a dozen or so students who meet one evening a week in the living room of the house. I try to select students with different interests, from different departments of the university, with the idea of getting to know a small but varied sample of the student body. We decide on some topic for discussion during the semester, but whatever the official topic, two subjects—education and sex—always come up, and always generate heated arguments.

I suppose there is nothing new about the interest in sex, although the talk does seem to me more open and general than it was in my own student days. But the preoccupation with education on the part of the students—with subject matter and methods of teaching—does strike me as new. Sure, we used to grouse about the requirements and talk about professors we didn't like, but I don't remember any vocal rebellion about the system or any serious discussion of alternatives. Now students, faculty, administration, and the public in general all seem to be deeply concerned. This is partly a consequence of sheer numbers, resulting in the complex and impersonal "multiversity," and partly the consequence of the post-Sputnik pressures for intensified training, especially in the sciences.

But my purpose here is to look not at the general problems that have developed in our educational system—for which I have no solutions—but at the special case of the role of natural history in high school and college. I'll not try to define natural history—its nature is reflected by the contents of this magazine, which include aspects of anthropology, geology, geography, and astronomy, as well as biology. My specific conce
is with biology—with the approach
the study of living things. My i
pression from discussions with no
science students confirms my ov
belief that the present emphasis
the teaching of biology is misplac
—giving far too little attention to
tivities of living animals and plan

Biology has generally become
required subject in high scho
usually at the sophomore level. M
colleges have adopted the princi
of "distribution," meaning that eve
student should be exposed to a nu
ber of courses in the natural scienc
social sciences, and humanities, a
must at least have a certain level
skill in mathematics and some f
eign language. The idea is to devel
broadly educated citizens by
quainting them with a variety of d
ferent kinds of knowledge. T
mostly involves taking introduct
courses. It seems to me that int
ductory courses are designed for
purpose of discouraging interest
the particular subject—and that th
are generally successful. The troub
of course, is that the instructors
apt to be most interested in
minority of students who will pos
bly be future specialists in the fie
in question. The others presumal
acquire understanding through so
obscure process of contagion; h
ever, I suspect the rate of infect
is not very high.

The situation in biology see
particularly dismal—an opinion t
I share with a large number of
colleagues, though we are far fr
agreement on what should be d
about it. One difficulty is a basic s
among biologists themselves on
matter of where emphasis should
placed in teaching. The eminent p

ontologist George Gaylord Simpson has discussed this in an article in the summer issue of *The American Scholar,* under the title "The Crisis in Biology." Simpson distinguishes between "molecular" and "organismal" biology: between the scientists interested in the physics and chemistry of living processes and those interested in the workings of the organisms themselves.

This distinction is probably more logical than the one I have long made between the "skin-in" and "skin-out" aspects of biology. I meant to separate the study of the way the parts of an organism work from the study of the whole animal or plant—its behavior, its place in the biological community and in the evolutionary scheme. The anatomist or physiologist may still be interested in seeing how the parts go together to make the whole organism, but the molecular biologists often seem to lose sight of the whole organism in their pursuit of chemical details.

The physico-chemical point of view toward life has a long history, but it is currently particularly fashionable because of a series of undeniably important discoveries. The most notable and talked-about of these concern the determination of the structures of the nucleic acids DNA and RNA, which seem to lie at the basis of heredity. But there is still much to learn. Simpson quotes "one of the stormy petrels of biology" as saying that to consider "that DNA is the 'secret of life' is less true . . . than hat life is the secret of DNA."

Teachers and textbook writers unlerstandably want to reflect the most recent developments in their subject, and this means, as Simpson remarks, hat "biology students may be taught recent and esoteric bits of biochemistry but not the systematics, physiology and ecology of organisms." Plants and animals are still with us, however; and it seems to me that the most important thing that he ordinary student should get from biology is some understanding of the orms of life with which we share he planet, and their relationships among themselves and with our species. I don't worry about the future pecialist, because in the long run e will have to educate himself—the eacher's problem in this case is to ncourage him and to be available nd helpful in whatever way he can.

I like to distinguish between edu-

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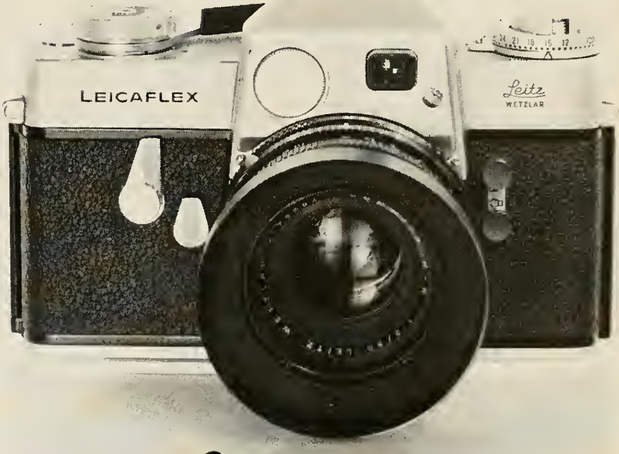

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cation, which I take to be concerned with ideas and understanding, and training in particular skills and techniques. Education in this sense should help us to cope with our own problems and with the problems of our society and of mankind as a whole. The great problems that face mankind, as I see them, are the population explosion; the threat—and reality—of war; the conservation or wise management of resources; and the maintenance of a healthy environment. None of these can be considered purely biological: since the concern is with people, the whole range of the social sciences is involved. But the human species is a part of the earth's biosphere, so that biological concepts and facts are also relevant and important. Yet the pertinent parts of biology, of natural history—ecology, behavior, systematics, even evolutionary theory—get little attention in our textbooks and lectures.

At the University of Michigan I try to meet this problem with a course called "Zoology in Human Affairs" (the title was not my idea, but it leaves me free to talk about almost anything). Enrollment is limited to juniors and seniors who are not science majors. I can thus presume some previous experience with such subjects as psychology, anthropology, sociology, economics, and the like. To preserve my own sanity, I try to make the course somewhat different each year. But I also try always to cover to some extent such topics as the organization and interrelatedness of biological communities (including the man-altered landscape); the dynamics of animal populations, emphasizing the peculiarities of the present human situation; the history of ideas about evolution and man's place in nature; the epidemiology (natural history) of disease, chiefly because it has been my own special research interest; and animal behavior with emphasis on aspects that may be relevant to our own evolution and development.

After a couple of experiments, I have abandoned the idea of using a textbook. I want the students to find that reading about biology can be interesting as well as instructive, so I have them get four or five paperback trade books. I have made one exception to the use of paperbacks. I want some book to give a background of the ideas of ecology, and after trying a number of the avail-

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le paperbacks, I have, for the last ree years, settled on Peter Farb's *ology* in the "Life Nature Li- ary." Like all of the "Life" books is beautifully illustrated, and some- ing I hope students want to keep. Whether or not to use one of my n books remains an open question. one time or another I have tried *e Nature of Natural History*, *The rest and the Sea*, and *Man in Na- re*, but I always have a guilty nscience because I feel that the idents get enough of me in listen- g to the lectures—and besides, it ps me from making cracks about ofessors who use their own books. *King Solomon's Ring*, by Konrad renz, is a perennial favorite. It is, they say, "anecdotal," but I can plain the psychological theories out animal behavior in lecture. orge Schaller's *The Year of the rilla* gives them a special case of ield study of one of the great apes, d I try to sketch the other recent idies of wild primates in lecture. is year I am trying Darwin's *yage of the Beagle*. It should give em a glimpse of geographical di- rsity, some insight into the Darwin rsonality, and a feeling for a natu- l history not yet permeated by olutionary thought.

Each year I try one or two books ave not used before. If the major- of the students find a book dull, lo not use it again, regardless of personal opinion. I want the terial to be accurate, but I also nt the reader to enjoy the experi- ce. I am trying to give the students appreciation of the scientific en- prise through exposure to a few ects of "organismal" biology. I do t see how they can get this by morizing the names for the ap- dages of the crayfish, or even by ing to master the chemical com- xities of intracellular metabolism. I like the remark made by Joseph od Krutch in his book *The Great ain of Life*: "To proceed from the section of earthworms to the dis- tion of cats . . . is not necessarily learn reverence for life or to de- op any of the various kinds of eling for nature' which many of old naturalists believed was the ential thing. To expect such irses to do anything of the sort as sensible as it would be to ex- t an apprenticed embalmer to erge with a greater love and re- ct for his fellow man."

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A Consequence Of Togetherness

The inability of the North American mountain sheep to disperse into new habitat stems from the inheritance of social traditions

by Valerius Geist

During the last century, large populations of bighorn sheep grazed widely from central British Columbia to northern Mexico, and from the coastal mountains of California to the Black Hills of the Dakotas. But with the opening of the West, the bighorns (*Ovis canadensis*) dwindled in number and finally disappeared from most of their former range. Protective measures enacted at the turn of the century failed to reverse their fortunes, and ever since they have existed only in small, widely scattered bands. Some of these relic populations have occasionally increased in size, but they have never recolonized the large amount of former living space available to them. Although the ranges of Dall's and Stone's sheep (*O. dalli* and *O. d. stonei*) are remote and less vulnerable to human invasion, a similar predicament exists for these animals. In short, the North American mountain sheep appear to be incapable of dispersal.

In contrast to the sheep, moose (*Alces alces*) and white-tailed deer (*Odocoileus virginianus*) have made spectacular acquisitions of new territory and have succeeded in increasing their numbers throughout most of their North American range. Why this differential success in acquiring new living space between the sheep and these ungulates?

We know that the former ranges are still acceptable to sheep, for reintroduced populations have generally done well. From twenty-nine reintroductions made on this continent, whose success can be evaluated today, twenty-two have proven successful. And the failure of others may have been due to improper release methods rather than to unsatisfactory range conditions. However, reintroduced populations behave much like the natural relic populations. They remain small in number and generally fail to spread far from the release sites, although an occasional animal may be seen a great distance from his companions.

Nor are sheep physically limited from dispersing. They are most capable migrants and in their travels often swim lakes or rivers and cross over rock rubble and cliffs. In late winter they often travel from mountain to mountain on frozen snow crusts without breaking through. They can go anywhere deer or moose can, and many places they cannot.

Apparently, sheep dislike entering timber, and it is thought that wooded valleys act as barriers to dispersion. Bighorns, for instance, which had become so tame that they followed me at heel as I conducted my field research, rarely went more than one hundred paces into the timber before they left me and returned to the open slopes. Similarly, migratory routes tend to take the shortest distance between mountains and to skirt forest; yet, during regular, seasonal migrations of natural populations, sheep may cross miles of dense timber.

The North American sheep's failure to disperse away from established ranges becomes the more unusual when we remember that, on a world-wide basis, sheep have distribute over a great area. They are foun from southwestern Europe, throug Asia Minor, the Himalayas, centra Asia, eastern Siberia, Alaska, wester Canada, the western United States and Mexico. No other living bovi equals, let alone surpasses, such a distribution. Since sheep have sprea through so vast a range, why are the failing in North America today?

Between 1961 and 1966, fiel studies of several natural population of North American sheep suggeste an answer to their inability to exten their ranges. During this period, m observations indicated that shee maintain their areas of distributio by passing on home ranges fro generation to generation as a livin tradition. Each generation of shee inherits the home ranges of its elders that is, they acquire the same habit of living in certain areas at specifi seasons, and of using the same migratory routes. Exploration apparentl plays a most insignificant part in establishing the home range of an individual. Moose and deer, howeve extend their areas of distribution vi individual exploration. Neither traditions nor a means of passing the are discernible in the life history o these two species.

If home range traditions are t exist, then there must be a continuou association between donors and receivers, a condition satisfied by shee Moreover, sheep society provides fo leadership by the elders, reinforce acquired habits, and, by minimizin disruptions in social life, provide

The solitary moose and the gregarious mountain sheep have developed different means of social behavior as a result of the habitats in which each species evolved. As a juvenile, the moose leaves the family group to take up residence in new territory, but the sheep remains a member of a band throughout most of its life, inherits the traditions of the group, and fails to investigate the availability of new living space. The moose is faring well in North America while the sheep is generally unsuccessful.

Lambs are born into female bands containing young of both sexes. Female sheep (above) remain with this band for life, acquiring its home ranges and migratory traditions. At about three years of age, males (below) leave the female bands and join groups of rams, which have different, though equally stable, home ranges. In areas where sheep are harassed by man, portions of the range are given up and are never reinhabited by the animals.

no impetus for independent exploration. A comparison between the separation of mother and young in moose and sheep is instructive in this regard.

While the cow moose forms a close relationship with her calf, the female sheep and her lamb live in a rather loose association. But in an abrupt change of behavior, when the female moose is about to give birth to another calf she turns on her yearling and drives it off. The life of the young animal is changed suddenly and violently. Within a few days it changes from a social to a solitary existence. for no cow moose will tolerate the yearling close by and the bulls are little better. The calf is now on his own, and begins the wanderings that eventually lead to the establishment of a new home range.

In contrast, the young sheep experiences no such upheaval. About one week after birth, the lamb begins to associate with other lambs in a band. After it is weaned, the bond with its mother commences to weaken, and the young sheep will follow other animals, preferably an old, barren female, which may even run and play with the youngster. Eventually, the lamb loses all preference for its mother over other sheep.

The important feature of this separation is that the offspring is not chased away and thus does not lose contact with other sheep. Of 283 bighorn yearlings observed between May 15 and June 30, in 1964 and 1965, 76 per cent followed some adult ewe, 15.5 per cent followed an adult ram, 5 per cent followed a subadult heep (two years old), 3.2 per cent ollowed other yearlings. Only 1 per ent were seen alone.

Observation of tagged or marked heep has shown that females, but not males, acquire the home ranges of the female band they are born in. Only rarely do young females leave heir band and accept the traditions of another group. When after a prolonged absence I returned to my Stone's sheep study area, I found known female sheep in the expected localities. They were feeding on the ame slopes, resting in the same faorite beds, and entering the same aves they had frequented three years revious. In fact they behaved so much in the familiar manner that I felt I had never been away from them.

Young males gradually break with the movement pattern of their female band, by joining male bands that have other, equally stable home ranges. In his third summer, when the young ram begins to search out male bands, he shows a weak, but discernible, wandering phase. In July and August, up to one third of all such little rams may be seen alone, or in the company of a companion of equal age. After his third summer, the ram is again a dedicated follower of older sheep—and remains such till, with increasing age, he gradually becomes more independent and is then followed in turn.

Generally the leader of a ram band is an animal at least eight years old, with long, massive horns. By following these older sheep, the younger rams get to know the wintering areas, the salt licks, the rutting grounds, the summer ranges, and the migratory routes, which have been passed on through the generations. In general, by following the choices of their leaders, younger males acquire those habits that allowed their leaders to grow old: habits that are constant and predictable. Thus, it is evident that sheep society is virtually designed for the passage of habits.

Two-year-old rams can and do stray into areas uninhabited by sheep, yet they will not remain unless accompanied by other animals. If we observe such a single, wandering ram we will note that he often climbs on elevated sites and scans the country below. He calls loudly—which all lone sheep do when traveling. These young rams are apparently searching for other sheep. If they do hit upon unoccupied good habitat, they are not likely to remain. for a habitat without companions is simply not a suitable place for a sheep to live. Furthermore. young rams cannot lead other animals into a newly discovered range, for they have not yet become leaders of a band. Thus, the range extension performed by dispersing juvenile moose will not occur in mountain sheep.

Unlike moose or deer, mountain sheep seem able to disperse only as groups, if they disperse at all. We have no direct data on this, save one introduced population that moved, as a whole, twenty-five to thirty miles to a different locality, but field observations revealed a possible means by which this might have been accomplished. In spring, groups of young rams occasionally go on long excursions into the valleys. Apparently, the "group spirit" of such a band is a strong enough factor to permit the sheep to overcome their reluctance to enter even small patches of timber. Thus, a band may leave an inhabited mountain to visit a nearby, unpopulated area, if intervening timber is not particularly dense. Once a visit has been made, the rams are almost certain to return, since they experienced the new habitat in the presence of companions. However, these group excursions can only occur if the sheep population is large enough to provide large bands of young rams that will discover and retain the new range.

How is it that sheep have developed one system of range establishment and retention, while moose have adopted quite different methods? This question appears particularly apt when we consider that sheep are faring relatively poorly compared to moose. The answer seems to stem from the fact that the habitats of these two species have shaped the evolution of different social systems, which in turn have determined the means by which these animals acquire living space.

Throughout much of its range in America, the moose is found in communities of deciduous shrubs and trees, which follow in the wake of forest fires. Such moose habitat flourishes some years after a fire and allows moose to build up large populations in response to the rich food supply. As coniferous climax forests slowly displace the deciduous species on which the animals feed. the populations decline and vanish. Mature timber, hot summers. and lightning storms assure moose new living space, albeit a rather temporary one. Today, man-made forest fires and logging operations play an important role in the creation of new habitat, although man's intrusion is a relatively recent influence that probably had little effect upon the animal's social evolution.

We find moose not only in the

short-lived "burn habitat" created by forest fires but also in small areas with permanent shrub communities, such as on rich alluvial soils along watercourses—particularly in deltas—and on south-facing mountain slopes above timber line, as in northern British Columbia. These limited localities assure a small amount of permanent living space to moose, where they can survive in the absence of habitat created by forest fires.

Under these conditions, the practice of juvenile dispersion serves an important function in maintaining and extending the moose population. Young animals wander out on their own, chance upon burn habitat, establish new ranges, and become the ancestors of large populations that will remain in an area until the habitat disappears. Since the vast majority of moose habitat is short-lived, traditions of range retention would be useless to them. Such traditions would return the animals to increasingly poorer habitat and finally to no habitat at all. Moreover, sizable herds of moose—needed to transmit such traditions—could not be maintained on small patches of permanent habitat. Moose are large animals, and where a few can survive, a dozen would eat themselves out of house and home. Thus, if moose were to develop a social tolerance for one another as sheep have, the resulting "group living" might cause their extinction.

Sheep habitat, whether in California's Death Valley or beyond the Arctic Circle in Alaska's Brooks Range, is always characterized by an open, mountainous landscape and stable plant communities. Most sheep are found on grasslands, which regenerate themselves and do not vanish within a few sheep generations as moose burn habitat does. Today sheep habitat is usually found in small, often widely dispersed patches. These may be separated by brush flats, glaciers, lakes, or wide belts of timber in the valleys. Natural populations of sheep link such patches of habitat via migratory routes inherited from their ancestors.

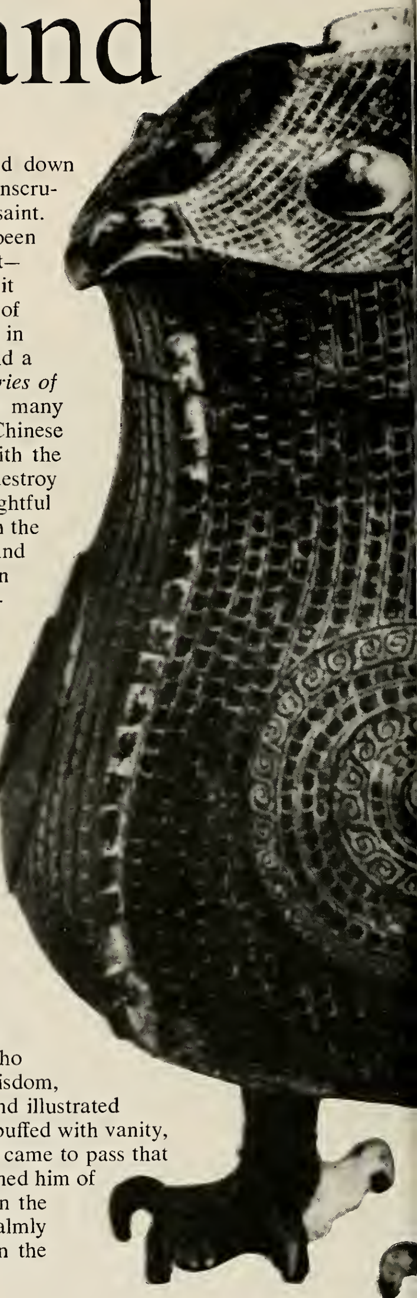
The distribution of sheep tells us that today's habitat is only the remnant of much larger grasslands that existed shortly after the glaciers withdrew. In later millennia, forests spread along the valleys and ascended mountain slopes, thereby dividing and squeezing mountain grasslands into ever smaller patches. Much sheep habitat vanished, but the remainder was retained by the sheep's home range and migratory traditions—the animals continued to exploit all available patches of habitat. Under these conditions, there is no selection in favor of dispersing juveniles since all the habitat they would normally encounter is already occupied. By leaving adults and moving off through miles of unsuitable territory, juveniles would only increase their chances of getting killed. In relic populations that make long migrations between patches of habitat, selection will favor those animals that remain in the company of others. Any behavior that disrupts this association between young and old sheep will be selected against. Traditions of habitat retention are therefore desirable for sheep, whereas juvenile dispersal is not.

Upon the sheep's evolved habits of range retention, however, must be superimposed the recent intrusion of man. After climatic and vegetal changes had forced sheep to link patches of suitable habitat by means of migratory routes, the coming of man destroyed many of these links—as well as the sheep. Thus, in much of North America, sheep now live in scattered populations, despite the presence of nearby habitat. But this set of conditions is a man-made artifact not previously encountered by the species and to which it lacks a meaningful response. When sheep are exterminated or alienated from certain mountains, the migratory traditions die out, for no surviving adult will return to where it is harassed and no young sheep will be led to it. Once an area has been "forgotten" by a population, sheep are then incapable of returning, even if the area is close at hand. Furthermore, reintroductions appear to me as only a partial solution. Once sheep are stocked on an unfamiliar mountain, the animals' lack of familiarity with the new habitat tends to make them cling to the immediate vicinity. Their exploration is limited to open territory connected to the original area of introduction. They rarely cross timbered valleys and other barrier that may separate them from nearby potential range. While in natura populations, the males move off t their own areas; in the introduce populations, they share the are (which may be a single mountain with the ewes. This limits the available food supply via competition an prevents significant growth in numbers. The ideal solution would necessitate a knowledge of access route to nearby habitat, but this knowledg does not exist. Thus, dispersal is unlikely. The problem is further complicated if men inhabit nearby area for this will generally frighten shee and restrict their activity to the undisturbed parts of a range.

Thus it seems that the evolutio of the mountain sheep's means o maintaining its population has n prepared the species for coexistenc with man. The contraction of suitabl habitat following the glacial retre has brought about the traditions o range establishment and migratio which have recently been disrupte by human interference. If this inte ference persists, sheep face an unce tain future. But if a means is foun to re-establish migratory routes b tween patches of available habitat, believe the animals will overcom their earlier setbacks.

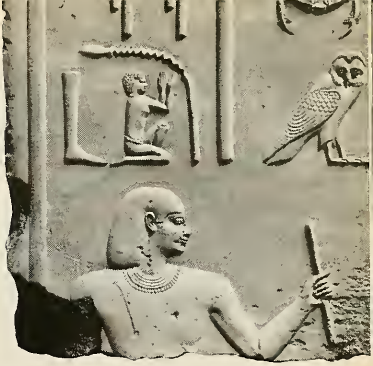
Editor's Note: After forty-thre months spent in the field researc ing the mountain sheep, Valeri Geist found that these animals wou eat from his hand, follow him abou even play "hide and seek" with hi This behavior conflicts with t rather stereotyped notion that she are wild and unapproachable. Ho ever, it suggests an answer to t problem mentioned in his article the sheep's inability to spread in new habitat from their establish home ranges. In a recent letter, D Geist stated: "A little patience, ta and delicacy can turn these shy cre tures into pets, or even into a n sance. Although I have not yet tri to lead a band of sheep into an ar it does not regularly visit. I am su it can be done. I believe they can tamed and made to use salt licks th are progressively moved into new t ritory, thereby establishing migr tory routes which would be follow by succeeding generations."

The Owl and

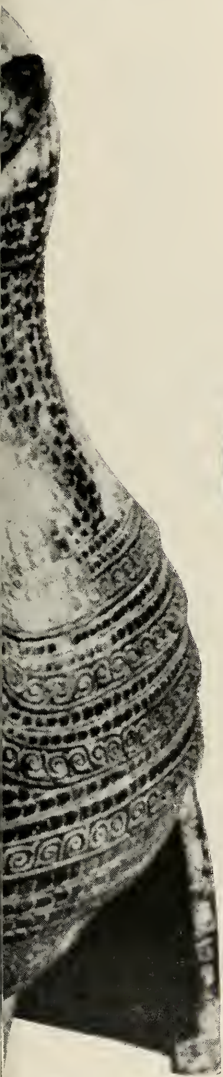


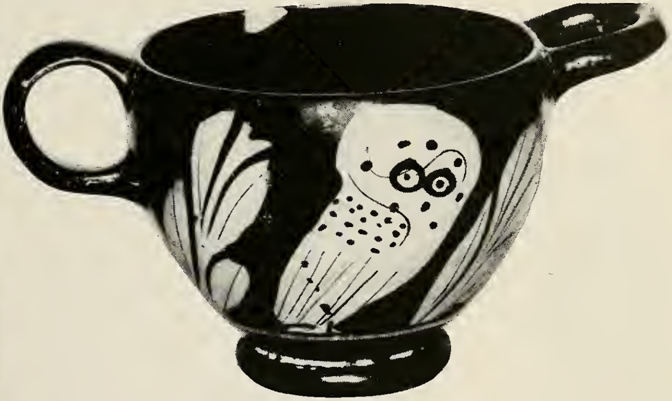
The owl has fascinated mankind throughout the world and down through the centuries. Sometimes this bird with the staring, inscrutable eyes has been worshiped as a lofty oracle or a patron saint. But at other times and in other places, human beings have been terrified by the creature that flies so silently through the night—and then shatters darkness with its bloodcurdling voice. So it is not surprising that the owl has also been feared as a bird of ill omen and an evil sorcerer, a bird that the Bible never casts in a kindly light. For example: "I am a brother to dragons, and a companion to owls (Job 30:29)." In her new book, *Centuries of Owls* (Silvermine Publishers Inc.), Faith Medlin reveals many other ways in which man has viewed the owl. The ancient Chinese and the early Indians of Peru both noted that this bird with the sharply hooked beak preyed on creatures, notably mice, that destroy man's crops. Elsewhere it has played a leading role in delightful folktales and fables. And the accompanying illustrations from the book show how the bird has intrigued artists of all times and climes, beginning with an engraving on a cave wall in southern France at least 17,000 years ago. Since then, through Michelangelo to Picasso, owls have been painted, etched, engraved, sculptured; they have appeared on vases, peace pipes, tableware; they have been portrayed with high embellishment and, sometimes, artistic wit. We know more about owls now than did Aristotle when he wrote of only the little horned owl, listing one species as unpalatable and the other as a food delicacy. By 1758, thanks to Linnaeus, the list included nineteen eared owls and thirty-one earless ones. We also know that owls do see in the daytime, and some species hunt then. They can do this because of a protective third eyelid that shields the eye's highly sensitive retina. Mrs. Medlin goes on to quote ornithologist Oliver L. Austin's denial that an owl will keep turning its head to watch you until its neck twists off. This is a backwoods spoof; the owl can twist its head only 180 degrees. Besides, would the "wise old owl" be so stupid as to twist off its own neck? This could be called a moot question. On the one hand, we know that the ancient Greeks highly respected the sagacity of the bird who was a constant companion of Pallas Athena, goddess of wisdom, but on the other hand, we have the modern fable written and illustrated by James Thurber. He depicted the owl as a solemn dunce, puffed with vanity, whom the other animals had unwisely elected God. When it came to pass that he was leading them down a highway, the secretary bird warned him of danger ahead. The owl blinked and asked, "To wit?" When the secretary bird persisted, "Aren't you afraid?" the owl calmly replied, "Who?" and continued to march his subjects down the highway, right into a truck coming at fifty miles an hour.

the Artist

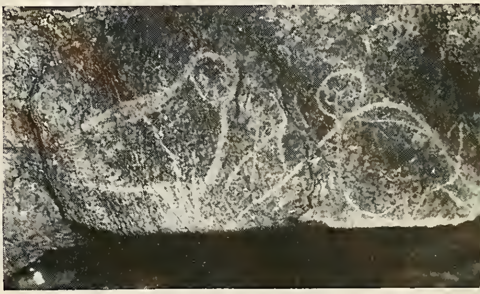


The owl sculptured on an Egyptian tomb dates back to the Saite period, about 600 B.C. It was believed such art had a spirit that would be of use to the entombed person.

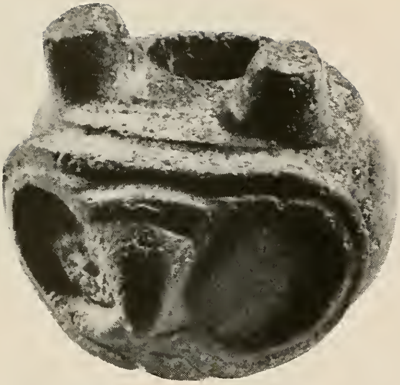




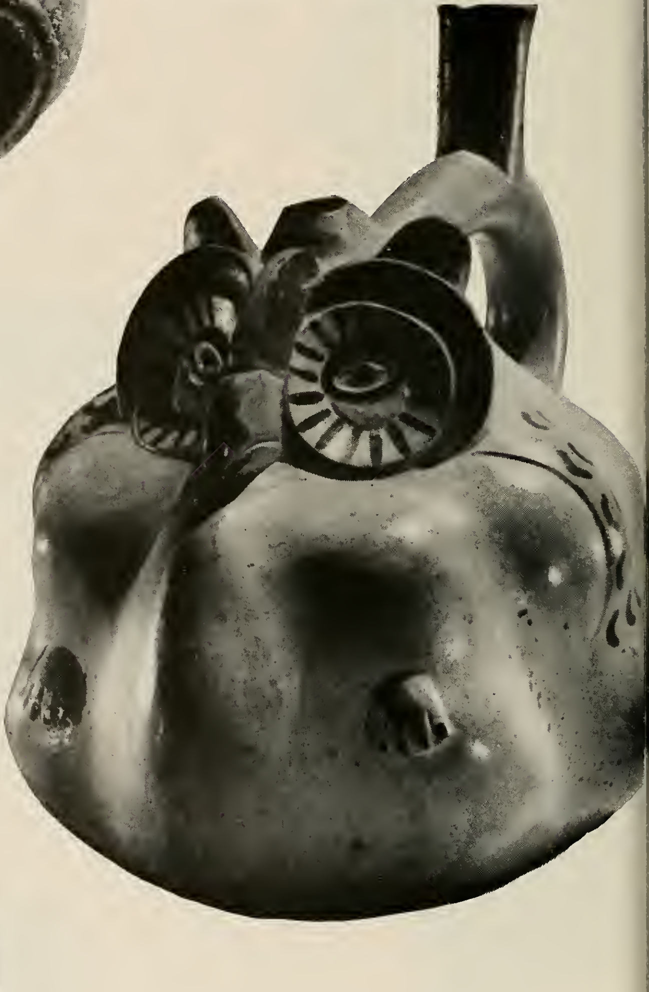
The scholarly bird above was painted on a kotyle—a measuring cup of ancient Athens, where owls were believed wise. Below: This prehistoric cave engraving in southern France shows a Snowy Owl with its mate and fledgling.



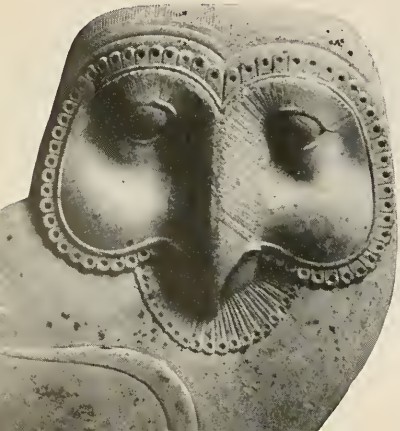
Above: In China, this bird cast in bronze was a foot-tall wine vessel used for ancestor worship ceremonies 3,000 years ago. Owning such an owl was a status symbol.



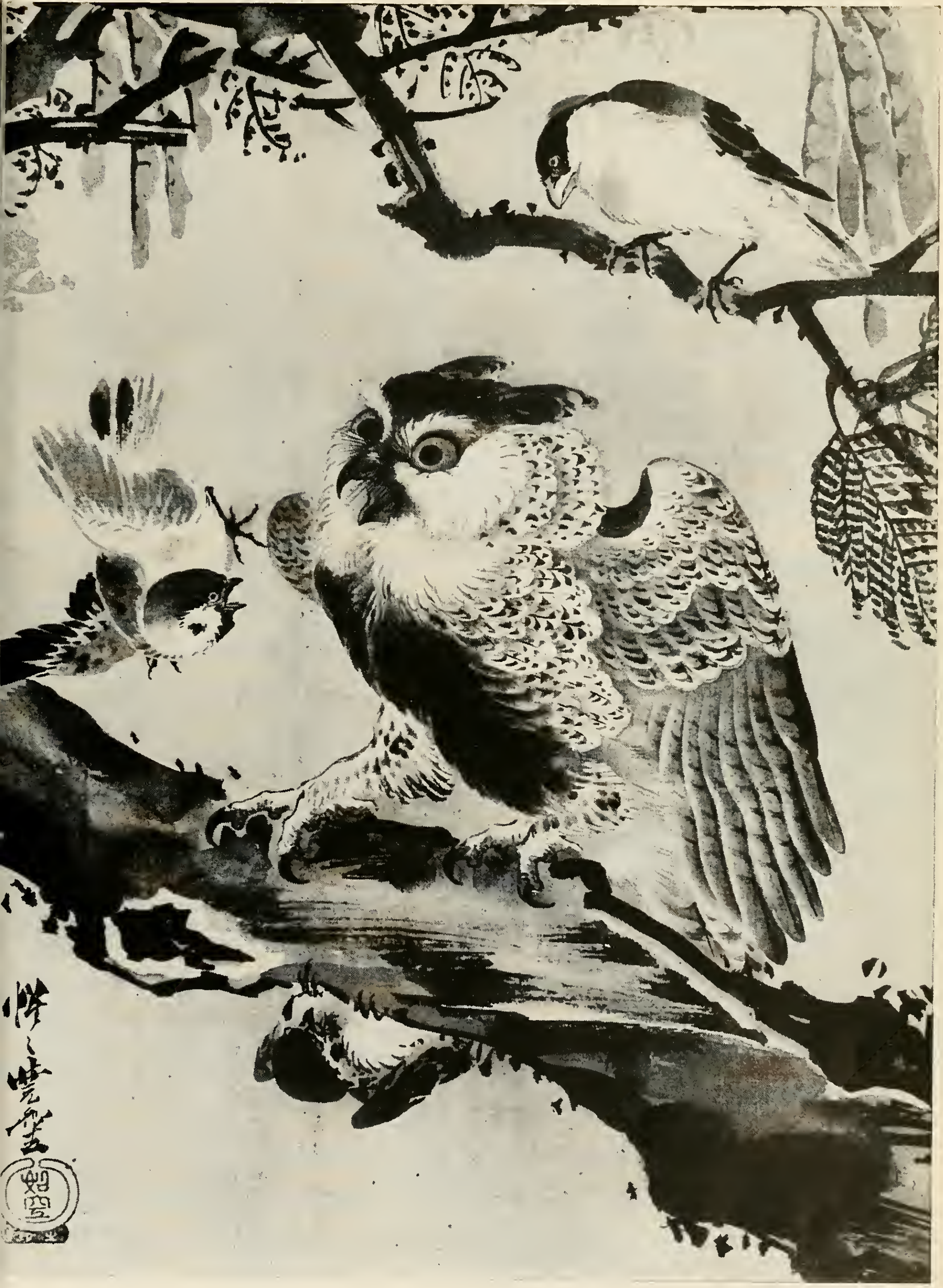
Left: In pre-Columbian Costa Rica the owl head became a savage mace—a stone carving hollowed to fit over a wooden club. Below: Less menacing was this bird-and-vegetable water jar made by the Mochica Indians of Peru. It has an owl head and a squash body.

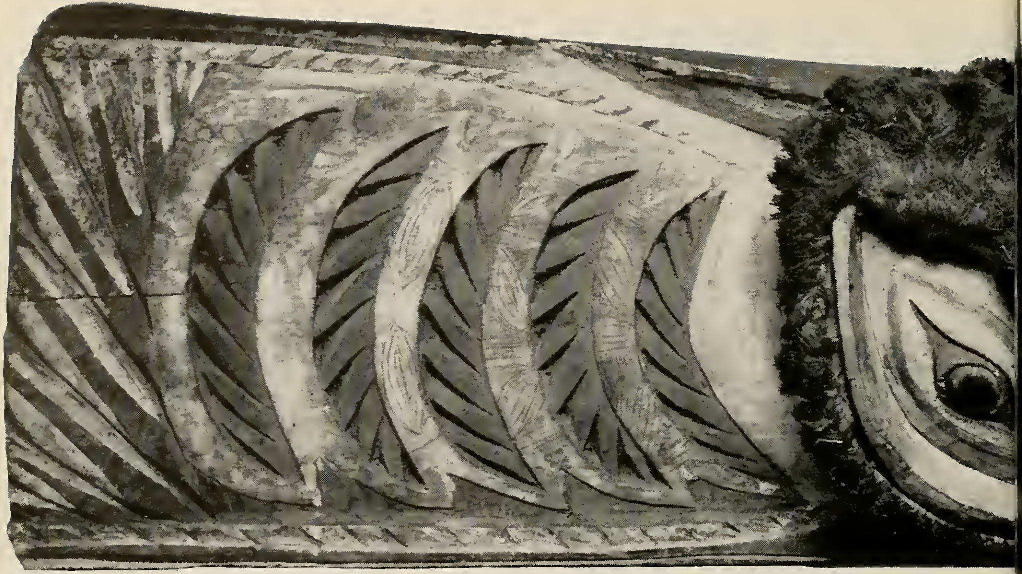


*Ancient Egypt had a "correct" way to delineate the owl. It appears here in a limestone relief (*circa *500 B.C.) used as a model for a sculpture class. Note that the body is in profile, but the head is shown in full view.*



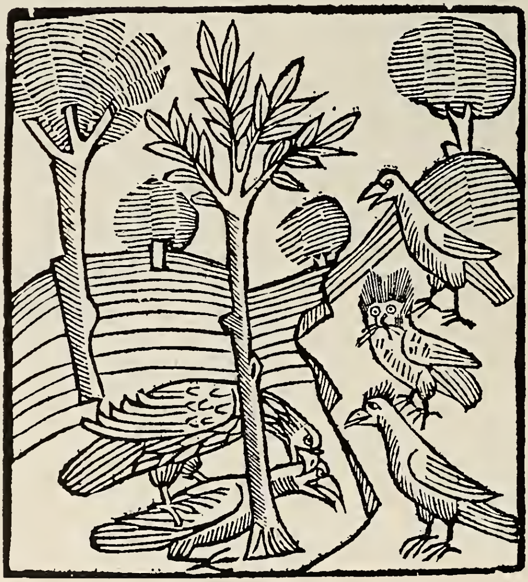
Right: Very different in theme an style is this "bully at bay"—proof tha some artists relish showing the nighttim predator being harassed in daytime "Owl Mocked by Small Birds" is by Japanes painter Kawanabe Kiosai (1831-1889)

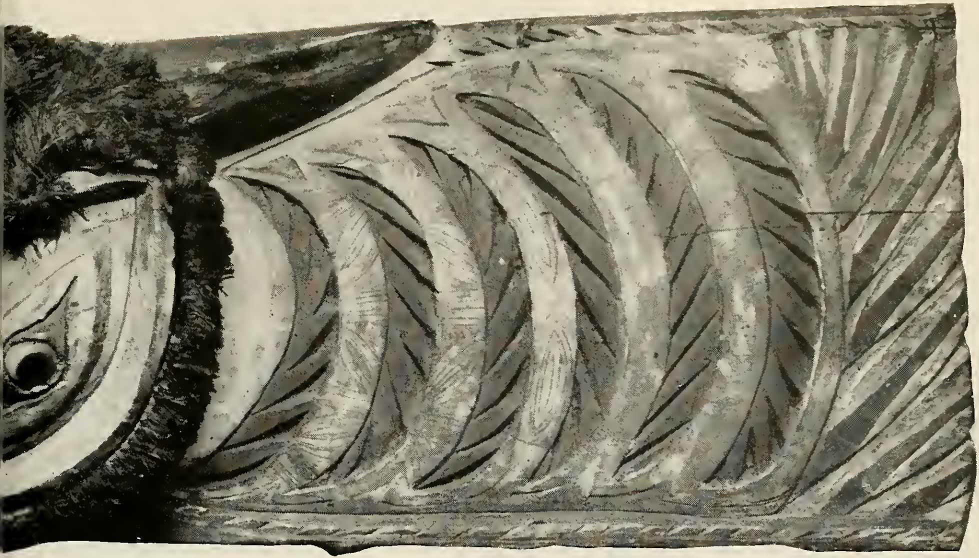

惺々暁斎
如空



Above: Before New Ireland was colonized, its natives used such owls in memorial fetes for the dead. The bird is carved on a board richly painted in various colors. Below: Many fablers have translated Aesop; many artists have lent a hand. In this woodcut from R. Pynson's translation (circa *1500) the owl, although stylized, is readily recognizable.*

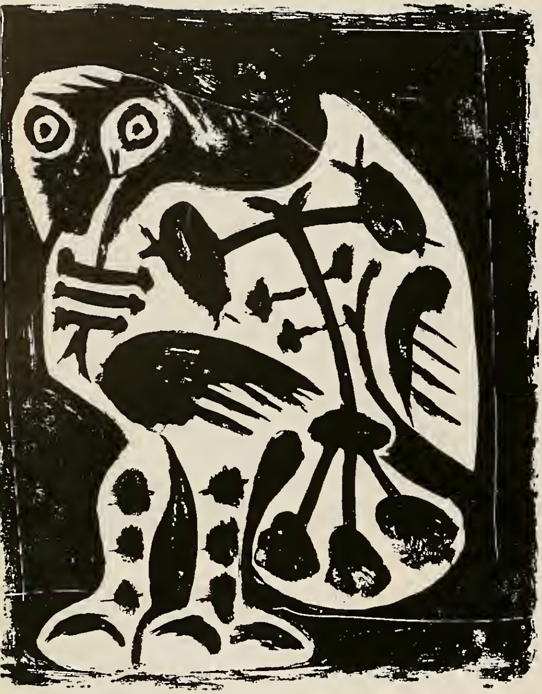
Michelangelo added an eagle-like owl to his statue of "Night," represented as a reclining nude. Under her knee, the sentinel keeps a staring vigil over darkness while the symbolic female slumbers.



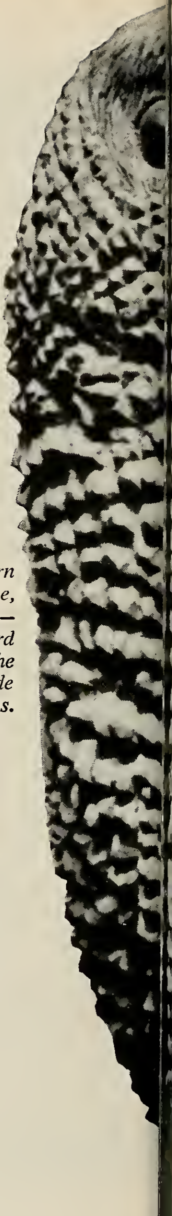


Below: Sioux warriors expected that a magic symbol painted on their shields would not only guard against enemy arrows; it would also repel bullets from the encroaching white man. Later, the practice became even more symbolic; the protective owl here is painted on a muslin "shirt" that covers the shield carried at the Ghost Dance.

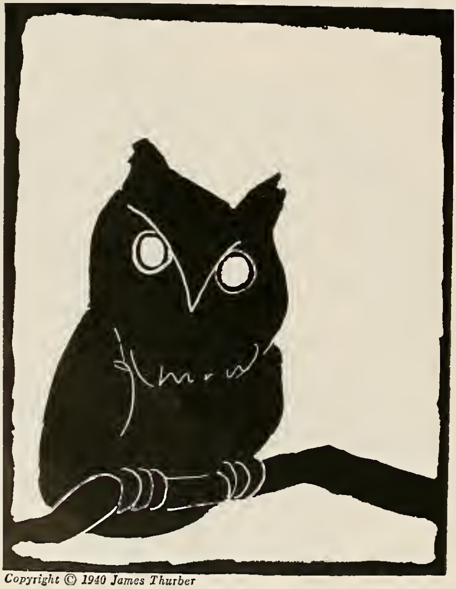
An owl of good cheer, the fanciful one hown above is a salt-glazed ceramic mug used for ceremonial drinking at court. It was fashioned more than 200 years ago by an artisan of Staffordshire, England.



Left: Aloof but commanding, this is "Le Grand Hibou," a 30-inch-high lithograph by le grand innovateur Picasso. His owls have also appeared in drawings, paintings, ceramics, and sculpture.

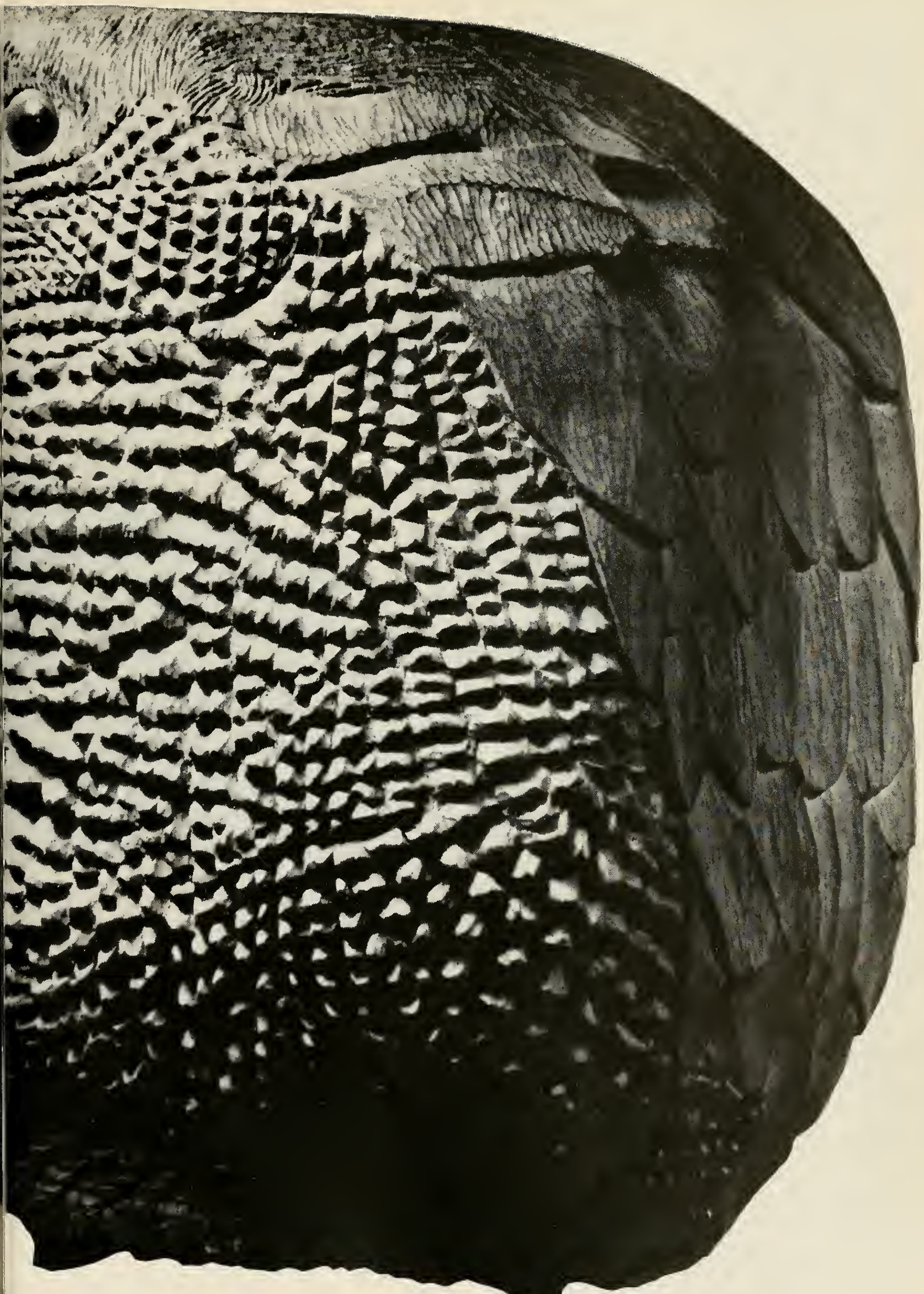


Right: This modern work—a meditative, plump bird 20½ inches tall—was carved in pine by Leonard Baskin. Other works by the Massachusetts artist include demonic owls with fierce talons.



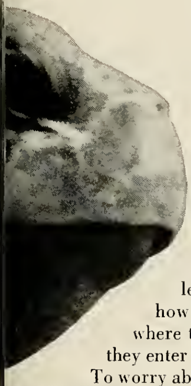
Copyright © 1940 James Thurber

Left: Unlike any other is the bird that the late James Thurber, writer and cartoonist, drew for his satiric fable The Owl Who Was God *—not to be confused with the owl in the attic or other Thurber whimsies.*



by ARCHIE CARR

Part II: 100 Turtle Eggs



NO ONE KNOWS WHERE THE TURTLES GO

Two of the stubborn problems of green turtle biology are how the baby turtles find the sea, and where they go during the months after they enter the surf.

To worry about the former of these may seem at first glance like nit picking. Why not suppose that e little turtles just look around and see the ocean out ere and walk out to where it is? But the answer is not at easy. The question has had a great deal of attention. e water-finding process seems to be essentially the ne in marine and fresh-water species, and zoologists ve made extensive observations of the behavior of tchlings of various species in an effort to decide what e cues are that lead them to the water. All these studies em to agree that the main sense involved is sight, and at some quality or quantity of the light out toward the is what leads the hatchlings in the right direction. yond that, little has been learned, and saying the guidest is some aspect of the illumination over the sea is t really saying much.

Sea turtles are among the most confirmedly aquatic of reptiles. In body form, musculature, and behavior ey are drastically modified for successful life in the ter. But they have retained one old reptilian feature at ties them to the land. That is the shelled egg that has be lodged on shore. The inconvenient, hazardous nestg venture on land complicates life for both the female tle and her young and is surely influential in deterning how many eggs must be laid to insure survival.

When a female turtle returns to the water after nesting, she never follows her incoming trail, so she cannot be guided back by the sign she laid coming in. When the return must be made from a place where the water is hidden by vegetation, topography, or debris, you have to conclude that a fairly fancy guidance process is being used. It also seems likely that the sea-finding ability of the female going back after nesting and that of hatchlings newly emerged from the nest must be the same, and both probably differ fundamentally from the orientation of the adult in its long-range migratory travel. A light-compass sense and probably, in some cases, a true navigation process are among the mechanisms that guide the migrating turtle. In the trip from the nest back to the water, however, orientation seems to be basically a tendency to move toward a special kind of illumination or away from the lack of it. The sea-finding feat and the long-range navigation are probably composite sensory processes in which a fundamental signal is repeatedly supplemented or reinforced by local signs. Of the two, the return to the sea is more easily studied experimentally, and it can serve as a helpful model for understanding high-seas navigation.

The trip of little turtles to the water begins when they break out of the nest. This may be located on unobstructed beach sloping evenly toward a sea that lies in full view. More likely, however, the location of the nest gives the hatchlings a first view of nothing but sand and sky. In either case the little turtles have to find the water, and unless they are eaten they nearly always do. After a

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few short false starts they begin to crawl and, almost at once, swing in the general direction of the sea. They move around, through, or over obstacles, and go up or down slopes with unswerving "confidence" in whatever sign it is that marks the ocean for them. They can find it by daylight or at night, in all weather except heavy rain, with the sun or moon hidden or shining brightly in any part of the sky. The main guiding cue is not yet understood. Later I'll try to show how thoroughly it is not understood and to tell of the things being done to learn something about it. Although sea finding quite evidently involves light, it is certainly not a simple tendency to move toward light. Otherwise the hatchlings would be expected to go directly toward the sun or moon, which they only rarely do. On the other hand, they sometimes do get distracted by an artificial light source, or even by some especially intense patch of natural light such as is provided by a hole in cloud cover. Most often, however, they move confidently toward the water, no matter what the condition of the sky may be.

After the soft dune sand is left behind and the turtles reach the hard tidal flat, the main guidepost can be supplemented by local signs. Besides the fundamental light-response, a chain of other signs and responses may affect the course or speed of the progress to water. White breakers in strong moonlight and fiery surf on phosphorescent nights both bring accelerated effort. At night a lantern beside the direct path to water often, but not always, distracts a train of hatchlings, and by day a shiny or white object may do the same. The hardness and smoothness of the ground may appear to cause them to move momentarily faster. When they come to a strong seaward slope the turtles may accelerate their pace somewhat, and if a reverse change occurs they slow down. If a log obstructs the way they move along it to the end, and then at once turn seaward again. No normal feature of beach topography either disrupts or replaces the response to the basic signal, whatever it may be.

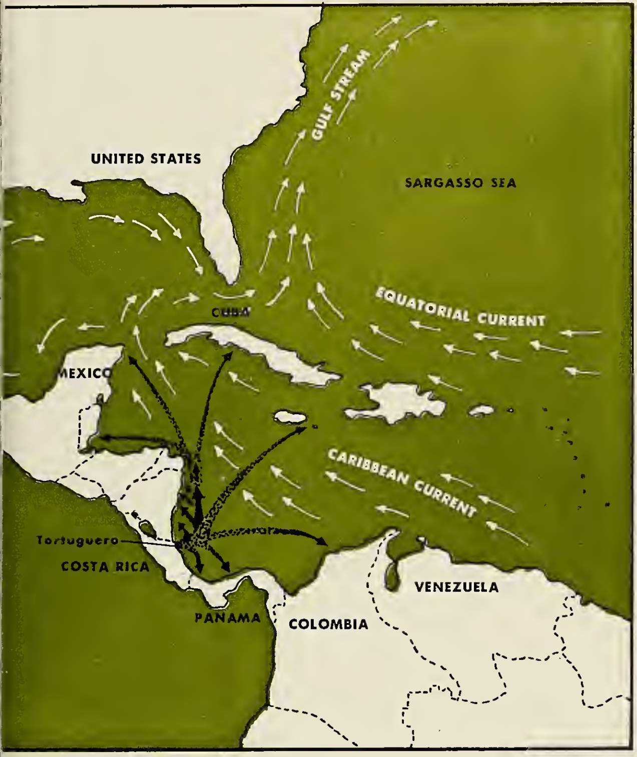
When sand wet by the highest waves is reached, another surge of speed and confidence is often shown, and some of the turtles may even break prematurely into short bursts of swimming strokes. The touch of the wet sand is evidently the cue that brings on this premature change of gait. When a wave slides up the flat and lifts the turtles, the flying swimstroke is instantly taken up by all the hatchlings; during the time that they are alternately lifted and stranded by the coming and going of the sheet flow, some confusion is evident among them. As each wave wash comes back, however, the hatchlings begin swimming forward toward the surf.

As the turtles reach deeper water they keep swimming seaward, dashing forward under water for a few feet, emerging to breathe and look around, then going down and moving ahead again. When they reach the breakers their heads go down as each crest grows white. Presumably they dive for the bottom and go under the plunge of the surf. This stage of the journey has not been observed closely, but a complex innate behavior is bound to be involved. In waves approaching shore, the relation between translation, plunge, and backwash, and between these and the position of the step in the bottom is complicated and variable. It is not really known how a turtle hatchling gets through a breaking wave. It is a normal obligation for them, however, and the fact that they do get through even the powerful surf of Pacific beaches suggests that they have strong adaptive adjustments to wave dynamics.

Various field experiments and observations show that the orientation process in the sea-finding ability of sea turtles is not based on compass sense. That is, the little turtles are not hatched out with an instinctive urge to go north to get to the sea, or south, if that should be the way the water is. After blindfold tests had virtually proved that the hatchlings needed their eyes for finding water, we carried out some crude experiments with females that had just nested and were therefore ready to return to the water. These were moved to various places between the sea and a lagoon that lay three hundred yards away through a coconut grove. In all the situations in which the ocean sky was clearly in view, the turtle went toward when released. Nearer the lago shore, however, where trees hid sky over the sea, the direction cho shifted, and all the turtles tes went into the lagoon. Likewi hatchlings taken just before eme ing from a nest at Tortuguero the Caribbean, flown across Co Rica to the Pacific shore, and th released and allowed to emerge fr an artificial nest back in the dun went directly to the strange oce even though it was completely h den from their sight.

The ability of the female to fi the water after nesting appears to the same as the juvenile sea-findi sense, and not a new capacity quired later in life. This seems in cated by tests with year-old turtl Tortuguero hatchlings, reared ages of nine and fourteen mon without seeing the ocean, found water readily when released on beach. Some of these had been k under natural light at Tortugue and others under artificial light the laboratory at the University Florida, where the period was sp in two-gallon tanks in which swi ming was limited. In some twen two trials with such turtles all fou the sea without major setback, ev when a variety of obstacles block the course to the water and hid from view.

It finally became obvious that tle more was going to be learr about the sea-finding sense by si ply watching turtles of differ backgrounds go back to the oce under different conditions weather, time and topograpl More searching tests would have be arranged, to show what featu turtles see in the beach landsca and what kinds of light they fi most attractive and most useful signs for sea finding. According Dr. David Ehrenfeld, of the Univ sity of Florida, began a series of periments in which he equipped t tles with changeable-lens spectacl The lenses were filters that let light of controlled wavelength modified the light in other way diffusing it, depolarizing it, or sim cutting down its intensity. In t way he was able to begin analyzi the natural light on the seashore a systematic way, using the turt



ark arrows indicate the distribution of tag recoveries from green turtles narked at Tortuguero, Costa Rica (1955-1959), and show only the spread from agging locality, not routes. Major currents are marked with white arrows.

hemselves as indicators to show vhat features of the light may point he way to the ocean.

Most of Ehrenfeld's early work vas done with adult females returnng to the sea after nesting. When he turtles were blindfolded—by puting cardboard squares into the pectacles—they traveled in hesitant ircles or blundered off on a course hat got them hopelessly tangled in he sea grapes and coco plums far up he beach away from the sea. So the xperiments clearly reinforced the onclusion we had arrived at some ime ago: that green turtles rely nainly on vision to find the water. t is, of course, possible that they lso can hear the surf or feel the ibrations caused by the pounding reakers, or that they can smell or aste water vapor or particles in the ir; but all non-visual senses together, if used at all, are not adequate to guide the turtles to the water when they are blindfolded.

When the cardboard squares in Ehrenfeld's turtle spectacles were replaced by special filters that only allowed some of the colors that make up ordinary white light to pass through, the turtles performed differently, depending upon the color they were allowed to see. A filter that let in light of green wavelengths seemed to make no difference to them. They crawled to the water as quickly and directly as if there were no filters at all. Blue filters caused a little trouble, but the difference in performance was so small that it probably was insignificant. When the blue or green filters were replaced with red, however, the sea-finding ability dropped markedly; the turtle took a long time to reach the water and often followed a devious route in getting there.

At that point it could be concluded that either there is something about green and blue light that tells the direction of the sea, or turtles see better in green and blue light and are simply using it in their inspection of the contours of the beach or of other features not yet identified.

Another possible source of seaward guidance is polarized light. The effect of this has also been studied by David Ehrenfeld. When light is reflected from any smooth, flat surface, such as the ocean or a highway, or when it is passed through certain transparent substances, a part of it is changed physically. It has been proved that this changed, or "polarized," light can be detected by honeybees and some other animals and is used by them as a celestial landmark in finding direction. To see whether turtles also use polarized light, depolarizing filters were placed in the spectacles. The filters made no difference at all in the ability of the turtles to find the water. It seems pretty clear that turtles do not rely on sea-polarized light in sea finding.

In October, 1965, Dr. Nicholas Mrosovsky, a British experimental psychologist who has done a lot of work with fresh-water turtles, came to the research station at Tortuguero to study the sea-finding problem in a different way. Instead of altering the natural light coming from the environment, Dr. Mrosovsky chose to supply the turtles with his own light of brightness and colors determined by filters at the source.

Working on the beach with portable battery-operated equipment, Mrosovsky gave baby turtles a choice between heading in the direction of the sea or turning at right angles to it in order to go toward a colored light placed at beach level. He found that blue and green lights could compete with the light from the sea in attracting the baby turtles. Red light was considerably less attractive. In another experiment Mrosovsky allowed the hatchlings to move toward either of two colored lights. In these tests the turtles showed a consistent preference for blue or green light over red, even when the red light was the brighter.

Continued on page 52

On th Snake River Lava

by Gerald A. Jayn

On the Snake River Plain in southern Idaho lie the lavas. From a distance, the beds appear dark, passive, and lifeless. There seems to be no break in the unvarying flatness of the terrain. But close up you can see that scattered junipers and shrubs and bright patches of lichens cover otherwise bare, black lava rock. The distant impression of levelness is also soon corrected by the numerous depressions, bulges, and fissures in the solid stone. It is peaceful enough now, yet the birth of this terrain must have been sudden and violent, as magma, at a temperature of 2,000 degrees Fahrenheit, erupted through weak spots in the earth's crust to flow over the ground, incinerating everything in its path.

Geologically recent lava beds are found in several states west of the Rocky Mountains. Idaho's Craters of the Moon National Monument, for example, contains some of the most spectacular effects of volcanic activity in North America.

One might wonder that plants could ever grow in an environment as stark and harsh as that of bare basalt. But by a well-known chain of events, a plant community will establish itself in apparently unlikely places. The only plant that can live on this newly solidified lava, and thus the first one seen, is the lichen. This pioneer is a symbiotic combination of algae and fungi, the algae producing the necessary food by photosynthesis and the fungi holding moisture. A lichen patch a few inches in diameter may live for centuries and spreads very slowly. One sees splotches of black, gray, orange, yellow, and chartreuse crust-type lichen in the lavas, growing on vertical as well as horizontal surfaces.

After a time, the wind will deposit small pockets of soil from surrounding areas here and there in depressions. Meanwhile, the chemical secretions of the lichens speed the erosion of the lava, which is as hard and firm as pavement. Moss then gains a foothold. One common species grows in contiguous spheres about an inch in diameter, the interiors of which hold soil particles that the moss has surrounded and captured. If you visit the lavas immediately after a shower, colors more vivid than usual will accentuate both moss and lichens. And you will also have the somewhat incredible experience of hearing the mosses absorb water.

After more soil has been wind-deposited and erosion has proceeded, other plants begin to take root. Most are angiosperms, or flowering plants; but another flowerless plant, the fern, also makes an appearance. Since fe
are generally associated with moist areas, and since t
annual precipitation in the region of the lavas averag
only eight to ten inches, the large ferns flourishing
the bottom of the deeper fissures seem out of place.

Sagebrush, that ubiquitous evergreen, invades t
lavas from the neighboring desert. Rabbitbrush thriv
and, in late summer, colors the scene with fuzzy yell
blossoms. Sweet-scented fern bush, with its finely lac
fernlike leaves, is found in the depressions and wid
fissures. Juniper trees, growing in a minimum of s
sometimes sending roots down into a narrow fissu
often develop into grotesque and twisted shapes. T
female trees are heavily laden with dark-blue berries
staple for local birds and rodents. In spite of its sha
spines, prickly-pear cactus furnishes food for roden
During late June and early July, the waxy, yellow bl
soms appear, along with a few red ones.

In June, the bright, semiparasitic early paintbru
springs up. Its color, varying from red to pink a
orange, is actually in the bracts rather than in t
blossoms. The stemless evening primrose presents a str
ing contrast when its large white blossom hugs nea
bare lava rock. One can find the yellow-blossom
cinquefoil, and if he is observant, the small, white bl
som of starflower. Large numbers of biscuitroot a
onions blossom in midsummer.

Animal life in the lavas is elusive. In summer,
meadowlark might sing in a juniper. A flock of horn
larks may flit overhead; you need binoculars to see t
beautiful yellow and black markings of the males. Haw
often hunt over the area or glide in the thermal u
drafts of a warm day. A mourning dove will startle
hiker, who may then find its nest with two white eg
under a slight overhang of basalt. Cottontails scur
about, as do jack rabbits and several species of grou
squirrels and mice.

One of the major charms of the lavas, in addition
the magic of its fiery birth, is that it has been lit
changed by man. Here is a near-wilderness area in t
midst of irrigated farmland and dry farms. It cannot
profitably grazed, mined, or timbered. Future expl
tation seems unlikely. Those of us who have learned
appreciate this strange land are glad that it is so ec
nomically barren. That way it has a good chance to co
tinue its succession undisturbed.

Lichens, moss, and ferns are thr
flowerless plants found on the lav

Fern bush and sagebrush (above)   Lichens (below)

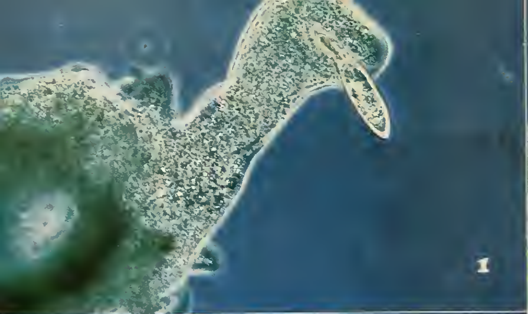
Evening primrose blossom (below)

Prickly-pear cactus (above)   Ice crystals (below)

Cactus, sagebrush, and grasses around a moss bed

Early paintbrush (above) Juniper berries (below)

Shrub-type lichen (above) Grass (below)



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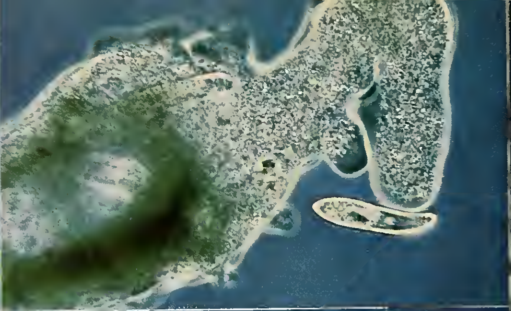

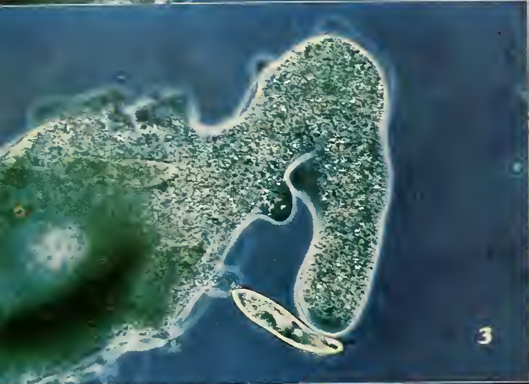

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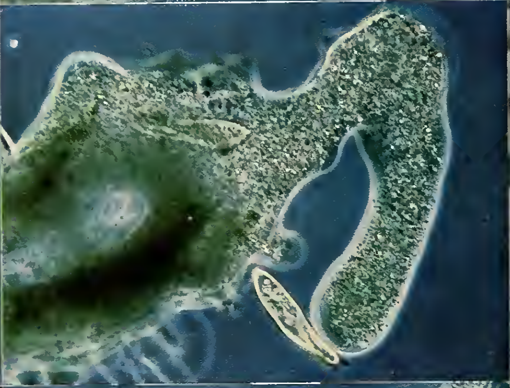

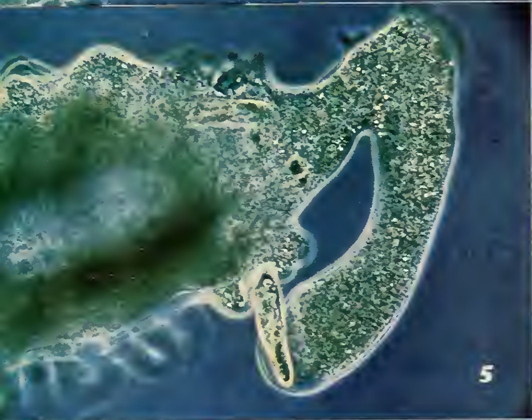

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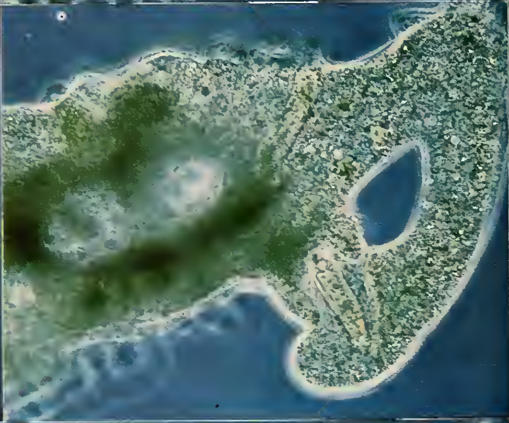
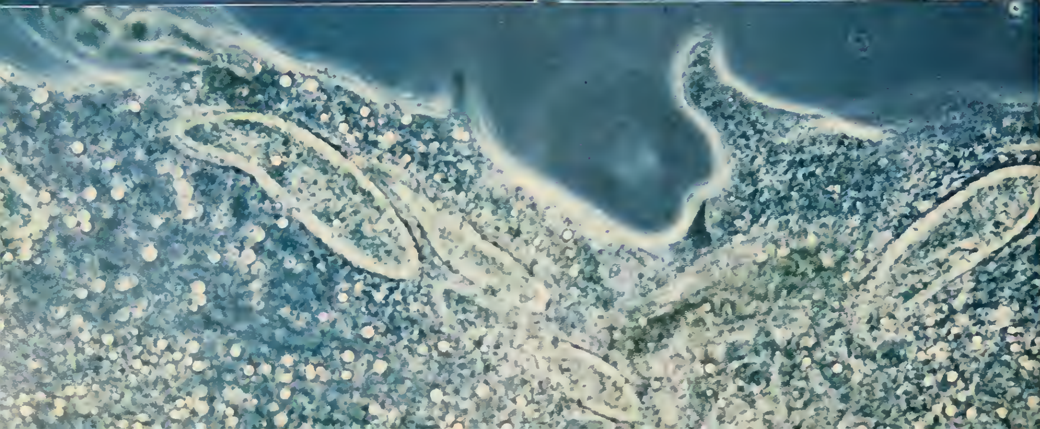




Chaos chaos

he giant amoeba eshapes its ingle cell to detect, levour, and ligest its prey

y Eric V. Gravé

One of the greediest animals of the microworld is the largest amoe- ı, known under various names: ant amoeba, *Pelomyxa carolinen-* ;, and sometimes, because of its rmlessness, *Chaos chaos.*

When food is scarce the giant ıoeba is rather motionless, but still ert, with its bulges, or pseudopods alse feet), at rest. As soon as a op of water containing a good sup- y of paramecia is added to a slide which the amoeba is being ob- rved, however, the listless lump of otoplasm becomes visibly excited. en before the paramecia have a ance to reach the amoeba, life ems to return to the pseudopods. It probably the commotion stirred up the drop of water by the paramecia ıt the amoeba, a very sensitive ani- ıl, is able to perceive.

Although a giant among protozo- s, it has no definite shape or size. hen not extended. this amoeba may no larger than 1 mm. in diameter; etched out it can reach a length 5 mm., thus becoming visible to naked eye. Still, the whole animal only one cell—a huge one as cells —which is capable of performing the functions necessary to sustain life and to reproduce. It has ap- ximately 1,000 minute nuclei, h 20 microns (20/1,000 mm.) ge. (They are too small to be vis- e in the illustrations at left.)

When reproducing, the single cell ides into two or more individuals. can divide without any nuclear inges; each new individual simply ains some of the nuclei distributed andom throughout the cytoplasm. If you watch an active amoeba ler the microscope you will see the cytoplasm in constant streaming, as blunt processes slowly protrude here and there. These are the pseudopods, which serve the animal both as means of locomotion and as tools to capture food. How the amoeba changes its shape—the mechanism used in the formation or withdrawal of pseudopods—is not known.

The giant amoeba belongs among the rarer organisms of the animal world. In general, to find it in nature is purely accidental. Its appearances are sporadic and have been reported from North Carolina. Virginia, Tennessee; even from a shallow pond in New York City, which, however, has since succumbed to the triumph of progress. Fortunately, man, whose conscience is so heavily burdened with the extinction of many animal species, came to the rescue of this protozoan. He took it to his laboratories, developed a culture medium on which the animal thrives, and created ideal living conditions for it in sterilized dishes all over the world. And why? Because this animal is exceptionally suitable for research. As a large protozoan, it is easy to work with and lends itself to the study of all kinds of problems of the free-living cell. The specimen pictured here was by no means collected from a pond; it came straight from a refrigerator of the Anatomy Department at Columbia University.

The giant amoeba will devour other protozoans besides paramecia if they are not too lively and vigilant to be caught. But the paramecium in the photomicrographs on the facing page has a habit that makes it especially easy prey.

When placed on a slide containing a giant amoeba, the paramecia first swim about aimlessly, but sooner or later one is bound to collide with the amoeba. And this is exactly the event the paramecium depends on to find a potential source of bacteria that may serve it as food. Thus the paramecium investigates the situation. Unsuspecting, it probes the soft body of the amoeba. It is this thigmotaxis, the orientation through contact and touch, that dooms the paramecium. The result of the probing is that the amoeba's appetite is further stimulated. The streaming of the protoplasm in the pseudopods is accelerated.

The sluggish amoeba then becomes quick and alert. If several paramecia are probing at the same time, pseudopods are sent out in all directions and are even capable of catching the victims simultaneously.

In the example shown in the photomicrographs, the amoeba seems to grab the prey and to direct it toward the body. In picture 3 new pseudopods start a surrounding maneuver. Up to the phase of picture 4 the paramecium, which behaves in a strangely passive way, could still retreat. If the prey does escape while there is still time, the streaming inside the pseudopods ceases abruptly and is soon reversed. In picture 5, however, its fate is sealed. Two additional pseudopods then reinforce the original one. In picture 6 they fuse. forming a vacuole from which there is no escape. Yet for a long time the victim can be seen swimming about in the vacuole, vainly searching for an exit.

Having ingested its fill, an amoeba rounds up. The movement of the pseudopods stops. The animal devotes itself to the digestion of the meal, which may sometimes involve numerous victims. Picture 7 shows part of an amoeba's body in which five paramecia can be seen in various stages of digestion. According to several observers. the prey, after a few hours, may be cut in half by the narrowing of the vacuole.

The photomicrographs were taken within a period of two minutes from the first contact in picture 1 until the formation of the vacuole in picture 6. All the magnifications are 160×, except for picture 7, which is 460×.

The mode of feeding shown here is actually a very common one in nature. On a much smaller scale it happens in our own bodies. The leucocytes, or white cells, in our blood are amoeboid cells. When we suffer an injury and subsequent infection. these cells migrate to the site of the lesion and engulf the invading bacteria in similar fashion.

SKY REPORTER

U.S. and Soviet space vehicles are scheduled to arrive at Venus this month in new efforts to probe the secrets beneath the cloud cover of earth's nearest neighbor.

The American Mariner V, expected to pass within 2,500 miles of the planet on October 19, will test the atmosphere and determine if the planet has a magnetic field similar to the earth's—a sign of a molten core.

The spacecraft will curve behind Venus (as seen from earth) and disappear for a few minutes. What happens to the radio signals from Mariner as they pass through the Venusian atmosphere will be important evidence on the composition and structure of the atmosphere.

The Soviet craft, Venus IV, is on a mission almost as mysterious as its target. Of three earlier Russian attempts, one missed the planet by 60,000 miles, one lost radio contact with earth, and one inadvertently crashed onto the planet. The United States explored Venus successfully with Mariner II in 1962.

GALACTIC DUST

The clouds of dust that prevent us from seeing into the center of our own Galaxy are themselves objects of interest.

Astronomers have been able to measure the density of the dust by calculating how much light it absorbs from stars behind it. They have tentatively decided the grains are elongated particles lying in the plane of the Galaxy because the dust tends to polarize light passing through it.

Now three astrophysicists at NASA's Institute for Space Studies in New York have begun taking the temperature of the dust grains by measuring the radiation they emit in the far infrared portion of the spectrum. William F. Hoffmann, Neville J. Woolf, and C. L. Frederick are making the measurements from balloons at 100,000 feet because radiation of this wavelength is absorbed by the atmosphere.

Results of the first flight, reported in the journal *Science*, place an upper limit on the temperature of 10 degrees Kelvin. Further refinement will make possible an informed guess as to whether the dust is composed of snow, ice, graphite, metallic needles, or rock dust.

The interstellar dust clouds are conspicuous to the most casual observer. The Milky Way in Cygnus—high in the western sky this month—is clearly divided by dark lanes, the clouds of dust.

A NEW COMET

An Australian schoolmaster discovered the third new comet of the year when it reached naked-eye visibility after sweeping unseen around the sun.

Herbert E. Mitchell made the sighting near Bowen, Queensland. Credit also went to independent discoverers in Brisbane and in Cordoba, Argentina. Setting just after the sun during July, Comet Mitchell-Jones-Gerber boasted a tail 7 degrees long at maximum. (The full moon is about half a degree wide.)

Moving southward through the sky at 2 degrees a day, the comet was best seen from the Southern Hemisphere. By the middle of August, it was at declination —30 d
grees. At least one amateur in the United States spotted
however, from a vantage point in Austin, Texas.

By the end of July, the comet's tail had shrunk to 1
degrees and the comet itself had faded to magnitude

John P. Wiley,

CELESTIAL EVENTS

Mars, Saturn, and Mercury are evening stars f
October. Mars appears low in the southwest at dusk,
the left and above the star Antares, in Scorpius, a
quite similar in brightness and color to the star. Duri
the month, Mars moves progressively farther east (lef
with respect to Antares. Saturn (magnitude +0.6) b
comes visible in the southeast after sundown, among t
faint stars of Pisces. Mercury may be found low in t
southwest during evening twilight for the first two wee
of October.

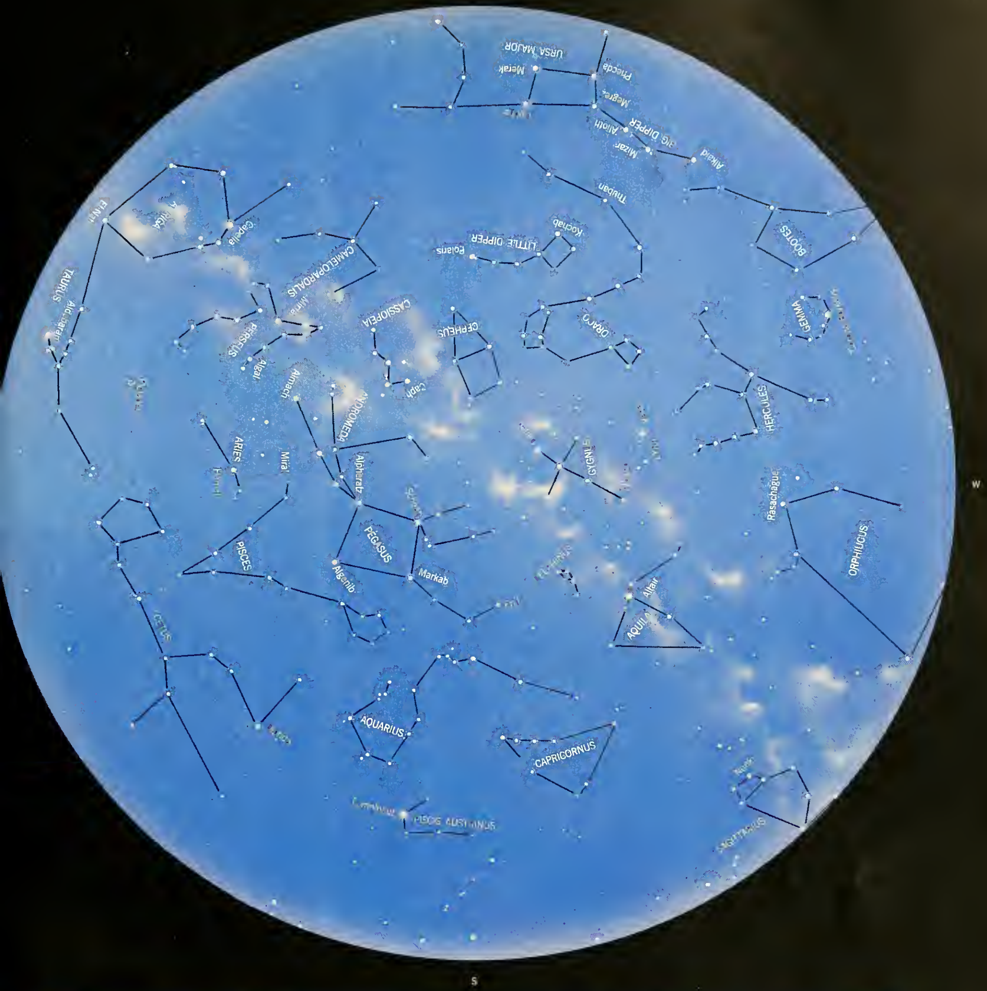
Venus and Jupiter are morning stars, rising in t
east before dawn and fading into the morning twilig
Jupiter (magnitude —1.4) rises about four hours befo
the sun; Venus (magnitude —4.2) about two hours aft
Jupiter. In the early morning twilight Venus is below a
left of Jupiter. On the morning of the 29th, the wani
crescent moon will be between the two planets.

Two interesting events occur about midmonth. In t
early evening of October 16, the nearly full moon w
pass between the earth and Saturn, producing an occ
tation of Saturn that can be seen in the eastern part
North America. Two days later, on October 18, the f
moon of October, the hunter's moon, passes through t
earth's shadow, and a total lunar eclipse will be visi
throughout most of North America. The partial pha
of the eclipse will begin at 3:25 A.M., EST; totality,
which the moon will be completely immersed in eart
shadow, will last from 4:45 A.M. until 5:46 A.M., EST; a
the end of the eclipse will occur at 7:05 A.M., EST. Tim
will be one hour earlier in each time zone to the we

Meteors radiating from the constellation Orion m
be seen in the early morning hours, when the constel
tion is rising in the southeast, during the last two wee
of the month. Maximum of the Orionid shower shou
occur on the 21st, but meteors from the broad stre
responsible for the shower often occur up to a we
before and after maximum.

Thomas D. Nichols

*Hold the star map so the compass direction you face is
the bottom; then match the lower stars with those in the
near the horizon. The celestial events chart shows times
rising and setting of the sun, moon, and principal plane
times of twilight; and sundial correction during the mon
Horizontal scale shows time; vertical scale shows dates. T
top strip locates bright stars, planets, and the moon wit
the zodiac. The horizontal scale of hours shows time wh
planets and certain stars are due south and highest at m
month. The phases of the moon shown are due south
highest on dates indicated.*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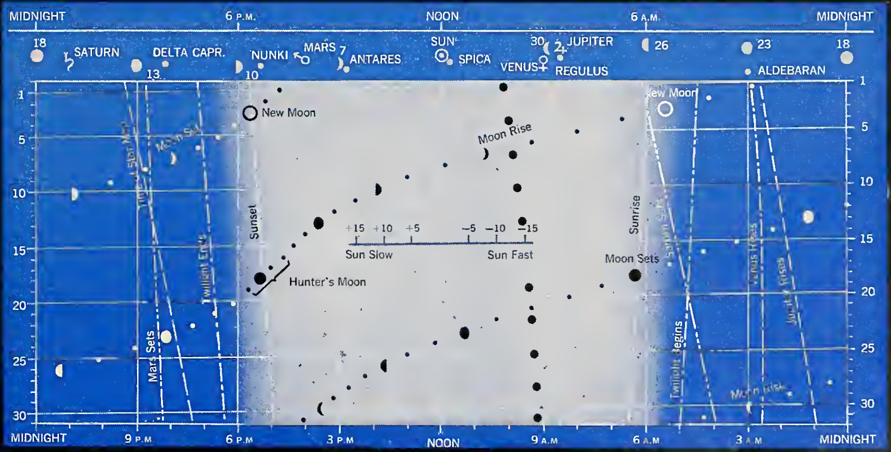
MIDNIGHT
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SUN
SPICA
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VENUS
JUPITER
REGULUS
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ALDEBARAN
18
New Moon
Moon Rise
Time of Star Map
Moon Sets
Sunset
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−10
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Sun Slow
Sun Fast
Sunrise
Hunter's Moon
Twilight Ends
Mars Sets
Moon Sets
Saturn Sets
Twilight Begins
Venus Rises
Jupiter Rises
Moon Rise
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MIDNIGHT
9 P.M.
6 P.M.
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NOON
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NO ONE KNOWS WHERE THE TURTLES GO *Continued from page 43*

In more recent experiments Ehrenfeld tried to see whether he could find any grounds for choosing between two sea-finding hypotheses suggested by his work with the mature turtles. Were they using some quality of light from the sky to find the sea, or were they relying upon the silhouette of the land to supply the information necessary to guide their movements? This time he took along a homemade, but very sensitive, portable spectrophotometer capable of measuring the brightness of the light of any visible color, and coming from any particular portion of the sky.

A testing arena was set up several yards from the sea, on the site that had been used by Mrosovsky for his experiments. This was a circular arena 42 feet in diameter surrounded by a wall 18 inches high. Twelve young palm trees were planted at regular intervals around the arena. The wall and palm trees were intended to hide the tree line and beach contours without blocking the light from the sky. At various times throughout the day and night, Ehrenfeld moved his spectrophotometer out to the center of the testing arena and measured amounts of red, blue, green, and polarized light coming from the sky over the sea and over the land. Immediately after taking these measurements he released batches of hatchlings in the center of the arena and recorded the directions they chose.

The results seemed to answer the questions being tested. The spectrophotometer showed no consistent differences between the light in the sky over the sea and that over the land, and the turtles in the walled arena were surprisingly disoriented. Some of them headed directly inland, even when the ocean was lapping against the far side of the arena wall. Many did not bother to move at all. When the wall and trees were removed, and other batches of young turtles were put into the arena, virtually all of them headed for the sea, even though it was still not visible.

From these experiments it seems that whatever the guidepost may be, it is not located high in the sky, but low over the horizon. The hatchlings do not raise their eyes to the sky for guidance toward the sea. A brief glance, or series of glances, about the landscape is apparen sufficient. Just what feature of t exposure or illumination provic the guidepost has still not be clearly determined. The tests ga some preliminary information the color vision of green turtl however. Although apparently r blind to any of the colors visil to man, they seem, at least wh on land, to be most sensitive green light. All of the conclusio reached so far are based on prelin nary experiments and need furth confirmation. Even this seeming trivial aspect of sea turtle life w have to have a great deal more stuc

Another puzzle in the natu history of little sea turtles, and o that surely hides factors of gre importance in determining the si of the egg complement, is the d appearance of the young for the first year of life. At most of t known nesting grounds the water front of the beach is wholly un habitat for the hatchlings. The treme exposure to predation by tra eling bands of surface fishes, the la of any conceivable source of fo on the wave-washed bottom, and t constant sweep of alongshore cu rents all make the home waters unlikely place for little turtles to st in; exhaustive searching has fail to find them there at any time af the hatching season.

It is, in fact, hard to see h enough hatchlings escape predatc to keep the race going. They ob ously do, however, and this anoma may one day help the effort to tra them during their first year of li

The negative results of a gr deal of searching of the shores the Caribbean, the Gulf of Mexi and the Atlantic coast of the Unit States have made me unwilling believe that little sea turtles mer follow shorelines when they mo away from the nesting beach af hatching. Throughout this area have systematically canvassed fishermen for clues. Along th coasts, hundreds of miles of sma meshed nets are regularly set dragged during the months of turtle-hatching season. Only wh nets are used adjacent to the ne ing beach are little turtles caug That they are caught there pro that they do not simply avoid n elsewhere. That they are not cau

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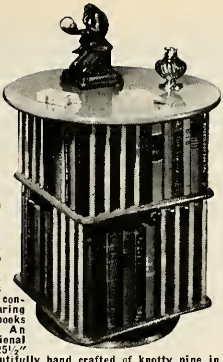

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on other sections of the shore suggests that they must move farther out to sea.

Other facts support that assumption. The coloration of the young green turtle is unlike that of the loggerhead, hawksbill, and ridley. It suggests that of free-swimming pelagic fishes: dark above and white below. This arrangement supposedly constitutes obliterative coloration for a creature that swims in the upper waters of the open sea. The white underparts make it less visible to a predator viewing it from below against the sky, while the dark back merges with the dark depths of the water to hide the turtle from water birds overhead. The green turtle shares this coloration with the leatherback, which is the most aquatic of all turtles and, indeed, the most completely pelagic of modern reptiles except the sea snakes or, perhaps, the Loch Ness "monster."

The feeding habits of little turtles kept in tanks may help one to visualize their habits during their early life in the sea. The smallness and weakness of their jaws must keep them in places where bite-sized or bitable food is available. In captivity they show a preference for animal food over plants—at least over the plants we furnish them. In tanks no more than two or three feet deep, they feed equally well at the bottom or at the surface. In deeper water, however, they have trouble finding and manipulating food on the bottom. In water four feet deep, baby sea turtles of all kinds would probably starve if fed only food that sinks. The natural habitat of young sea turtles, therefore, must be either very close to shore—which appears to be almost surely not the case—or at the surface in some part of the sea where there is a reliable supply of floating food.

Theories to account for the disappearance of little sea turtles are in one way like those that seek to explain how green turtles navigate: they are all preposterous. The most likely idea at present seems to be that the hatchlings for a time become plankton, that they drift more or less passively in the open sea. If this is the case, then it would seem reasonable to look for them downstream in the current that washes their natal shore. If on entering the water the hatchlings just swim out to sea for a certain distance and then relax, they must be picked up by any

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alongshore currents that are there and carried wherever the currents go.

The trouble with this theory is that nobody knows where the currents go. The little longshore drifts and eddies inside the major swirls like the Gulf Stream are very sketchily known, at least in the Caribbean. If you look at a chart that shows ocean currents, you see, off our turtle beach in Costa Rica, arrows that point to the northwestward. These show how the equatorial current, having just squeezed itself through passages among the easternmost Antilles, flows on up between the Yucatán Peninsula and Cuba, and into the Gulf of Mexico. It does some circling there, and then funnels out between Florida and Cuba and emerges in the Atlantic Ocean again, this time as the Gulf Stream. Looking at such a chart, and figuring from the trend of the major surface currents of the region, it might seem logical to search for the baby turtles in the place where the current comes close to shore in Yucatán or Cuba. A great deal of searching has been done there but no baby turtles have been found. Most of our tag returns, however, have come from localities in, or not far out of, this main northwesterly current. This may have some bearing on the problem of the disappearance of the hatchlings. But what? A lot of returns come from the other way too, from Panama and Colombia, and even from Venezuela. But all of these tags are from mature turtles. Both the northern and the southern tag-recovery sites are the grazing grounds of the grown-up, herbivorous animals. I have never seen a baby green turtle on these flats anywhere, and nobody I have talked with has seen one there. So the lead that the current at first appears to offer peters out, and you have to go on back to Tortuguero and take up the trail of the lost hatchlings once again.

I told of some of the signs that suggest that young green turtles are pelagic—that is, that their habitat is for a time the open ocean. There are some objections to this notion. The spry awareness little turtles have of the untrustworthy character of seabirds, and the obliterative effect of their white bellies and black backs could help explain how the hatchlings avoid being eaten at sea. But there would remain the puzzle of knowing how they are able to find anything to eat out there. There is only one place I can think of where at the surface of the open ocean there might be a concentration o small, soft-bodied, simple-minde animals that baby turtles could fin with no more active finding powe than they appear to have. That plac is among the floating rafts of sargasso weed, which drift in tropica currents and accumulate in vast volume in the Sargasso Sea.

Sargasso weed, or gulfweed, as i is also called, is the common nam given to a number of species o brown algae that grow on rock tropical shores. The plant has a long stemlike portion with flat, leaflik blades branching from it, an spherical floats as big as peas, whic help keep it up at the surface whe the sunlight is. The plants brea loose in rough weather and dri about with surface currents. Unles wrecked or thrown ashore by wav action they live on indefinitely. A lo of plants get caught in the Gul Stream and are swirled into the central North Atlantic, where they accumulate in the quiet center of th current system that circles that pa of the globe. This is the place know as the Sargasso Sea. It is a region o little rain and wind, a high evaporation rate, and clear, salty wate which stands at a higher level tha that of the surrounding ocean.

It is estimated that some ten million tons of sargasso float in tha tranquil sea. The weed accumulate there, partly because more of i drifts in on the Gulf Stream tha drifts out the other side on the equatorial current, and partly by vegetative reproduction. Algae wer pioneers in the art of sexual repr duction. The sargasso algae, however, are for some reason unable t procreate sexually. They simpl grow and reproduce by breaking o branches of themselves. The ind vidual plants probably never di unless they are smashed by wave Rachel Carson suggested that som of the sargasso weeds in the Sargass Sea today might have been seen b Columbus. In his time the place wa feared by mariners as a trap fo ships. It was fancied to be a soli field of clinging plants that hindere the progress of ships. This was, c course, an error of the times. Th weed is not that dense. There quite a lot of it out there, howeve and together with the peculiar co ditions of climate and hydrograph that prevail in the area, it makes th

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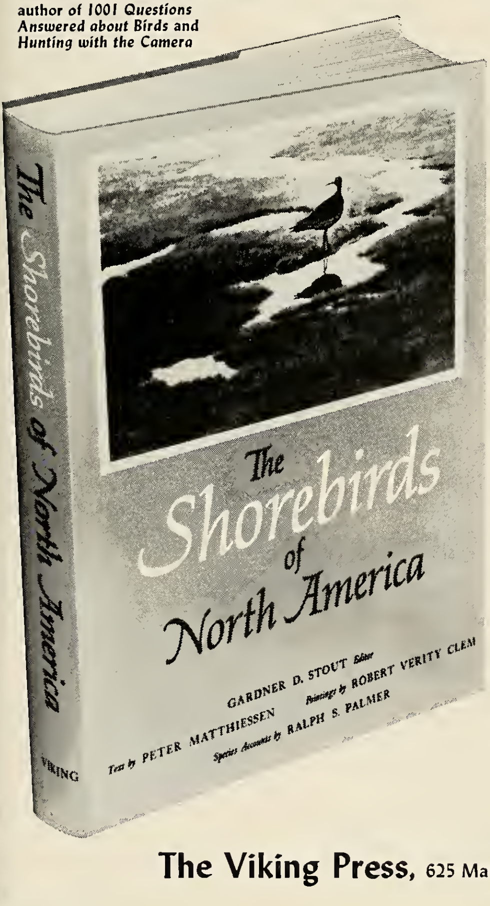
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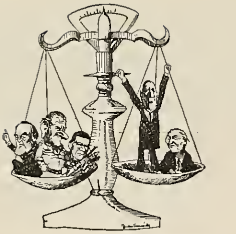

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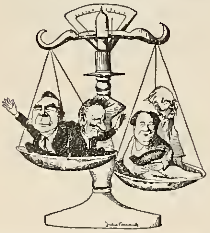

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Sargasso Sea one of the distinctive regions of the earth.

The Sargasso Sea is often referred to as a biological desert. What the people who call it that have in mind is the generally skimpy plankton and fish faunas in its water, which is warm, clear, and poor in nutrients. The sargasso weeds themselves, however, are by no means sterile. They have a diverse fauna of small creatures, most of which are strongly adapted by evolution to life in a gulfweed raft. In fact, a sargasso raft is an organized biological community integrated by a variety of ecological bonds. One only has to look at the sargassum fish, for example, to see the reality of the sargasso raft organization. The little fish is a classic case of concealing form and coloration. Sprigs of weed seem to sprout from it, sargasso berries are painted on its sides, and it even appears to be encrusted with the same tracery of small, limy worm tubes that decorate real sargasso weed.

The raft fauna ranges in body size from that of a multitude of tiny larval creatures that live there to the big, rambunctious dolphin, which seems strangely drawn to lurk about in the drifting weeds. There are pipefishes there and sea horses, filefishes too, and various kinds of crabs, octopuses, and sea slugs, all molded by natural selection in ways that let them find enhanced survival in rafts of sargasso weed.

A big gulfweed, therefore, wherever it may be found, is not just a drifting plant. It is an integrated company of different kinds of animals, vertebrate and invertebrate—grazers, scavengers, and savage predators—to all of which the weed is a source food, an asylum from attack, or a buoyant craft on which to cruise the warm currents of the world. And because these are precisely the requirements of a baby green turtle fresh through the surf. and off to wherever it is they go, why not suppose that they join up with the sargasso fauna for a while?

Bob and Gene Schroeder of Islamorada, on the Florida Keys, have kept hundreds of young green turtles in live cars. When they throw sargasso weed into the cars, the turtles scramble busily about the weed, eat some of it, forage through it for hidden bits of the ground fish the Schroeders feed them, and at night sleep supported by the rafts. Only a few sea turtle hatchlings have ever

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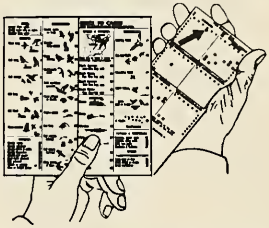

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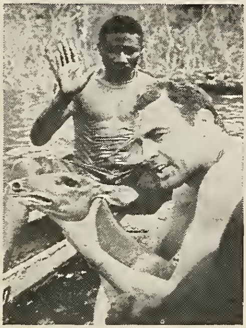

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been found in sargasso weed. One man found nine baby loggerheads in one raft in the Gulf Stream off Florida, and one or two loggerheads have been reported in weeds on a few other occasions. No green turtle hatchlings have as yet been found in sargasso, at least not by anybody able to identify them, or excited enough to tell about the discovery.

I ought to make it clear that I have never been able to locate a place, or anybody who knew of a place, where little sea turtles of *any* kind could be caught. Not even one little sea turtle. I never even heard rumors of the existence of such a place, and this is very significant, because all about the world fishermen are mostly zoologists at heart. Hardly any other aspect of the lives of sea turtles is left unmentioned in their folklore.

While we are waiting for somebody to find the habitat of young sea turtles it would be helpful to be able to mark hatchlings in a way that would make them recognizable when they reach maturity. It is, as I said, not even known whether the big female turtles that go ashore on a given beach hatched out on that beach a decade or more before. The strong site tenacity the females show in going back to a place for repeated nestings makes it reasonable to believe that they must have been born where they themselves nest. But this can be proved only by recoveries of mature turtles that were marked as hatchlings. And though it sounds like a simple thing, a permanent tag for a baby turtle is frustratingly hard to devise.

The trouble is finding a mark that will resist the changes a turtle undergoes when it grows from a three-ounce hatchling to a three-hundred-pound adult. Holes punched in the edge of the shell or flippers fill in or erode through to the margin. Notches sawed in the shell-edge open into wide emarginations as the shell grows, and then disappear completely. Branding the upper or lower shell makes a mark that might last if the size of the turtles stayed the same, but they grow so fast it soon becomes impossible to tell the brand from a barnacle scar or a coral scratch or, later on, from the marks made by the courting male. It is the same with tatooing. You put on a fine, clear, pigmented mark, and in three months the particles of ink have all spread apart or are hidden

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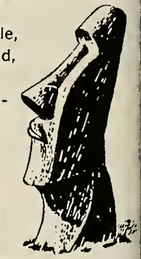

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nder thickening upper layers of
hell or skin. And the fastening on
f mechanical devices is completely
npracticable. Any external tag is
oon either overgrown or popped off
y the increasing thickness of the
ssues it perforates. A radioactive
g of some sort came to mind early
the sea turtle study. This was
uickly ruled out, however, because
f the risk of ill-feeling among peo-
le of the Caribbean, when they
ould learn of the plan to install
dioactive slugs in animals so es-
emed as human victuals. It could
e done in a harmless way, but it
ould make for prohibitively bad
ublic relations in a project that
epends on pan-Caribbean goodwill.

When plans for radioactive mark-
g of hatchlings dissolved, the idea
f a magnetic tag came up. Why not
et a lot of tiny magnets made of
me of the new alloys that make
ronger magnets than iron does,
d somehow install these inside
ousands of baby turtles? Of
urse, nobody without a magne-
meter would be able to tell a tagged
rtle from an untagged one; but
ith the right detection apparatus, it
ght to be possible to walk about
nong turtles in a crawl, or belly
in a fish house or turtle cannery,
on the deck of a Cayman schooner,
d pass the instrument over the
tside of the turtle and detect the
esence of any field of magnetism
at a magnet inside might be throw-
g out. The idea seemed promising.
was hard to figure a way to code
e magnets so that an individual
rtle could be recognized, but at
ast it seemed a way to identify a
rtuguero hatchling, for instance,
you found it as a twenty-five-
und Florida yearling, or if it
ould come ashore still later to nest
Tortuguero Beach.

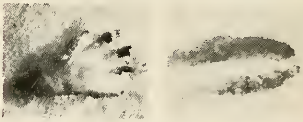
I looked around and had no trou-
locating an engineering com-
ny willing to furnish the magnets.
ey designed and made 20,000
autiful little magnets of a fancy
oy. They put them up like tiny
usages, in chains of ten, in tight-
ting tubes of Teflon. Each magnet
s a thin, shiny section of wire,
ly eight millimeters long. It could
sily be injected into a baby turtle
inserting an ordinary hypodermic
edle and then pushing the magnet
through the needle with a sterile
nger. They were lovely little
gnets, and we stuck a lot of them
o baby loggerheads, green turtles, and hawksbills, and the turtles seemed not to mind at all.

But this scheme went to pieces, too, when the contractor called one day to say that the magnetometer he had designed for the work had turned out to be able to detect the magnets at a distance of only five centimeters. An instrument sufficiently sensitive to detect the feeble field of our tags would cost nine times the original estimate, and even with that, the turtle being inspected would have to be given a very close going-over. The body of a sea turtle changes its form and dimensions drastically, and the little magnets seemed likely to shift about inside. Finding one of them in a turtle the size of a calf, which might be the only marked turtle among twenty other untagged ones, seemed just too shaky a prospect to work hopefully toward. Especially when you pondered that the detection was a blind search for a grown-up hatchling that had been one of a handful tagged, among millions of its year-group that got no recognition mark at all.

I don't know what to make of the fact that, as different as the habits of the five kinds of sea turtles are when they mature, the young of all of them remain equally hidden from view. I have talked mostly about *Chelonia* in this article, but only because more is known about it than about the others. The habitat of all hatchling sea turtles is unknown. It is a dilemma, therefore, whether to theorize about five kinds of lost hatchlings, or to try to trace them down one by one. I suppose both have to be done at once.

Wherever it is that hatchlings seem to lose themselves, they cannot be really lost. They must be in some pretty good place which, although not thought of by zoologists, is nevertheless altogether reasonable and proper for little turtles to be in. Until that place is found, there will be a big gap in the natural history of sea turtles. There will be unknown enemies of turtle hatchlings out in unknown places, and unknown ways to foil them. Famine and storms will be out there where the hatchlings are, and good things to eat, too, and calm seas for foraging. So long as this vital, vulnerable stage in the lives of sea turtles remains hidden from view, nobody can hope to know why a sea turtle lays a hundred eggs.

Follow the wild animals that made these tracks!



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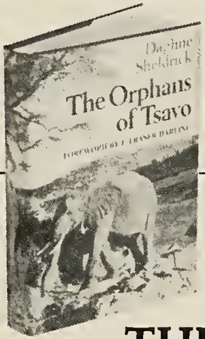

**THE
ORPHANS
OF TSAVO**

by Daphne Sheldrick

The wife of the game warden at Tsavo East, the vast national park located between Mombasa and Nairobi, tells the fascinating story of how her husband converted 8,000 square miles of trackless bush country into a great wildlife preserve. There they rescued and cared for orphaned animals until they were big enough to return to the wild and fend for themselves.

"The animals didn't always behave — the zebra ate the washing hung out to dry; Samson, the young elephant, turned on the outdoor water tap and, since he didn't turn it off, the Sheldricks' water bills were astronomical; Gregory Peck, an inquisitive weaver bird, fell into a pot of green paint. But usually the assorted menagerie wandered peacefully around the park headquarters where the Sheldricks could watch their behavior and come to know them as distinct personalities. David Sheldrick specified that the pets could go wild whenever they wished; some of them did, and a few returned for visits. An attractive and understanding book about African animals." — *Publishers' Weekly*

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Nature and the Camera

Photographing Wild Animals

by Patricia Caulfield

When I took up animal photography a number of years ago, my ignorance was such that I believed all the wonderful pictures of wild animals that I had seen were taken candidly: that is, to photograph a tiger you walked through his jungle with camera ready until you encountered him. With any luck, I figured this would take about half an hour. On confrontation, tiger would perform like the MGM lion, striking poses and emitting ferocious snarls. After, say, fifteen minutes of photogenic posturing, tiger might stroll off and occupy himself with tiger work, such as climbing trees or chasing deer, and the photographer, if tiger were agreeable, would be able to tag along and, in the highest tradition of photojournalism, document the action.

My confidence in the general applicability of such an approach to animal photography declined as my experience grew. The first lessons were learned in a situation that I now know was every nature photographer's dream: a rescue mission to remove animals from islands in a lake that was created when a South American river was dammed ("Surinam Animal Rescue," NATURAL HISTORY, January, 1966). As the water rose, the islands shrank, and the number of animals per square yard (and mile) increased, along with one's chances of finding them to photograph.

Even among the vastly greater than normal number of animals, however, I soon found that my documentary approach was not producing the pictures I wanted. It worked for the big action events, such as when deer or tapir were flushed from islands by teams of men and hunting dogs. And it worked whe five canoes full of Bush Negroes co verged to gang an animal and hog-t it for removal to the mainland. B these were action pictures of men wor ing with animals, not pictures of t animals themselves going about the usual rounds in their natural habita

When a team of highly compete and widely experienced nature photo raphers appeared on the scene, I w rescued from my ignorance. Did the spend every day in boats, hoping for random shot of a three-toed slot clinging to a branch or a red howl monkey in flight through the treetop as I had been doing for weeks? The did not. They stayed in camp and s up pictures using animals that we temporarily quartered there whi awaiting transport to safety. They di not waste their time in actual pursu of the big prey, for there was no gua antee that the boat one was in woul be on the spot when a deer or tapir w captured. Instead, after the animal w taken they released it in the water ne camp and filmed its recapture.

Following their lead, I was able t take pictures of wild animals lookin wild, but the technique was more th of a studio photographer than that of journalist. The animals could not b photographed in the jungle surroun ing the camp, which was on a still si able island. Many of the smaller sp cies were arboreal, and if you put the on a tree branch they would be up th tree and out of reach, both literal and photographically, within second So instead of using a real, rooted tre we would cut down a small tree ush, plant it in the clearing like a ence post, and place the animal on it. hen the fun would begin.

Most wild animals, large and small, ear man (and I can't say I blame iem). Unless cornered or ravenons, ven the big predators retreated from s, so I was not at all surprised by the ehavior of the smaller animals I was orking with. Their only impulse was put as much distance as possible etween me with my camera and themelves. Without help, therefore, my only ictures would have been of their backs s they fled to the opposite side of the ee from where I stood.

The assistant's job was to determine empirically and, sometimes, painlly) an animal's particular fight or ight distance—the distance a wild anial will allow between itself and the iemy without fleeing or fighting—and eep it at bay. This worked fine with ost of the arboreal animals I encounted (porcupines, tamandua, two-toed oths, pigmy anteaters, opossums, and on). One exception was the threeed sloth, probably the most phlegatic mammal in the world. Nothing ould induce a three-toed sloth to rike a defensive attitude, nor deter it om stodgily hauling itself up to the p of any suitable, vertical object, inuding oneself. The technique with a oth was to start it at the bottom of e tree, maneuver around taking picres as it climbed, remove it from the p, and repeat the performance. The her exception was the red howler onkeys, which, if released, would be f and away across the clearing before ie could make a single exposure. The ily way I could photograph these priates was to have someone hold them to try for a candid shot as they fled rough the trees.

If, then, it is so difficult to photoaph wild animals even under such eal circumstances as a rescue operain, where the supply of subjects and sistants is guaranteed, what is it like pursue them in the unspoiled wild? is usually more difficult and somenes impossible, depending on the bitat and the nature of the beasts.

Your photographic work with wild imals will probably be in specific pes of locations, and the photoaphic problems and possibilities both shooting (because of the physical ture of the region) and in camera d film care (because of the differces in climate and method of travel) ll vary, depending on whether you e working in the Tropics or the ctic; in swamps, jungle, or mounns; or in your own backyard. In ture columns I'll cover the methods nd other animal photographers have ind most valuable in the different cations, rather than organizing the terial for work with different animals. But first. here are some generalizations based on my own experience.

The most common and most effective method of guaranteeing a supply of wild animal subjects is to lure them with a free meal. The technique works equally well for tigers in India and small animals and birds on a suburban lawn. Relatives of mine who live on the outskirts of Rochester, New York, inadvertently attracted a large flock of pheasants and a family of opossums, to say nothing of numerous rabbits and squirrels, with the accidental overflow from a conventional bird feeder. Being animal lovers, they started purposely scattering feed on the ground to keep them coming. Unfortunately, I was there only for one evening and was not forewarned of the action, so I had to content myself with snapping a few shots of the opossums feeding with only the light of the bulb over the back door, and using a 50 mm. lens on a 35 mm. camera. On my next trip, I'll take along a tripod and long lenses, set them up in advance by the kichen window, and work on some more formal studies of suburban fauna.

Beyond suburbia, attracting animals is more difficult. Distasteful though the thought is, the bait for predators must sometimes be live. The technique is to pick a location with a good background, and tie bait there that your subject is known to relish. Once the predator discovers such easy prey he will return for more, and by rebaiting you can accustom him to the location. Only after the habit is formed should you commence shooting.

It is possible to stalk certain species in some regions, and in general the techniques for so doing are those of the hunter: staying upwind, moving stealthily, working from blinds, and so on. Don't be disappointed, however, if your results are less than outstanding. It is considerably easier to shoot an animal than to photograph it—after all, you don't even have to *see* much of the animal to kill it.

It may come as a surprise—as it does even to the most-advanced professional photographers who specialize in areas other than wildlife—that most of the superb animal pictures you see are set up in one way or another. The baiting technique may be all that's involved with the really wild animals. But many of the "wild" animals you see in pictures are not truly wild. They are the tame or partially tame pets, or at least possessions of, game wardens, animal collectors, or simply animal lovers with a taste for the exotic. More important than equipment, materials, and photographic techniques, therefore, is getting animal experts to help you. Park rangers, game wardens, biologists, bird watchers: follow their advice and enlist their aid for better animal photographs.

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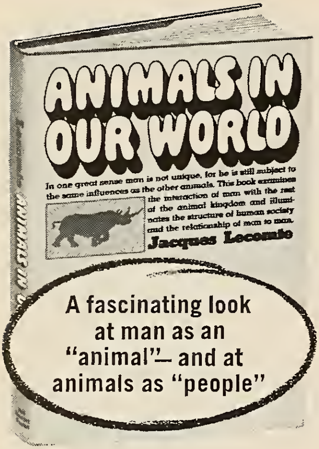
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Books in Review

The Biology of Philosophy

by Jane Oppenheimer

The Biology of Ultimate Concern, by Theodosius Dobzhansky. *New American Library, $5.00; 152 pp.*

Theodosius Dobzhansky, a distinguished biologist whose great contributions are in the realms of genetics as related to evolution, addresses himself in this well-written book to some philosophical problems related to biology. He emphasizes that the book "lays no claim to being a treatise either on philosophical biology or on biological philosophy." Rather, it attempts to present some biological facts, theories, and ideas that may contribute to a discussion of certain philosophical problems. He does not define philosophy in his own words (perhaps because of a certain insecurity, he frequently expresses his own ideas in the acknowledged words of others), but he tends to be sympathetic toward Bertrand Russell's definition: "between theology and science there is a No Man's Land, exposed to attacks from both sides; this No Man's Land is philosophy."

He recognizes that other definitions of philosophy involve the construction of a *Weltanschauung,* a word he believes to be untranslatable, and what the book primarily accomplishes is a formulation of Dobzhansky's own *Weltanschauung.* "Does my life and the lives of other people have any meaning? Does the world into which I am cast without my consent have any meaning? There are no final answers to these Big Questions, and probably there never will be any, if by answers one means precise, objective, provable certitudes. And yet seek for some sort of answers we must, because it is the highest glory of man's humanity that he is capable of searching for his own meaning and for the meaning of the Cosmos."

During the course of his own quest for some expression of the meaning of life, Dobzhansky has drawn not only on the materials of biology but also on those of anthropology, and to some degree from psychology. For justice to be done to the book, it should be reviewed by a critic more conversant both with technical philosophy and with a thropology than myself; I can spea about it only from the point of view a biologist with a much more limite knowledge of this field than the autho

Dobzhansky makes no attempt in th book to draw up a unified and orga ized system of philosophy; the book really a set of six separate essays more or less overlapping subjects. Th opening chapter on "Humanism a Humanity" is merely a brief introdu tion to what follows, presenting so definitions and clarifying the aims the book. Chapter 2, "On the Gods the Gaps," discusses possible aspec of explanation of gaps in our unde standing of nature: religious vers material views, mechanistic vers vitalistic views are taken up historica ly, and current opinions concerning r ductionism and compositionism a explored from the point of view of en bryology, genetics, and evolution, well as of philosophy. Chapter 3, "Evolution and Transcendence," di cusses inorganic, organic, and huma evolution. Dobzhansky believes ph nomena on the inorganic, organic, a human levels to be subject to differe laws peculiar to those levels. He a cepts that organic derives from ino ganic and humanity from what pr cedes it; he uses the phrase "evolutio ary transcendence" to define the a tainment of new levels in evolutiona history. (The otherwise excellent refe ence list fails to refer to Clifford Gro stein's wonderful discussion of levels organization in *Strategy of Life.*)

The evolutionary origins of the h man mind present problems that a touched upon throughout the boo Chapter 4, however, "Self-Awarene and Death-Awareness," dwells part ularly on self-awareness as "one of t fundamental, possibly the most fund mental, characteristic of the huma species . . . an evolutionary novelty The fifth chapter, "Search for Mea ing," takes up man as a social bein but as a social being of a special kin not only as a member of a family but an ethical member of a society that h developed religious views as to t

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meaning of life and that is now developing new views to supplant the older ones. Sartre comes in for consideration, as well as the old Christianity. The final essay, "The Teilhardian Synthesis," presents some of Dobzhansky's views, occasionally critical, but on the whole admiring, on Teilhard de Chardin's attempts to reconcile science and religion. Dobzhansky sees Teilhard de Chardin as "one of the most profound religious philosophers of our time." Will posterity agree with him? It is too soon to know.

To the benefit of the general reader, the essays raise more problems than they solve. Those relating to the origin of true novelty in evolution, of consciousness in particular, of creativity in general, remain open. Dobzhansky is of course at his best when he discusses the mechanisms of evolution, where he is surest of himself. But he is lucid throughout, and he expresses himself always in favor of man as a concerned, and inspirited, being. Here is the source of the "ultimate concern" of the title—in a quotation from Tillich to the effect that "ultimate concern is manifest in all creative functions of the human spirit."

Philosophy in one sense deals with universals; this book is the result of an attempt to deal with the development of a personal credo rather than a universal system of thought. What a man thinks personally is perhaps of greatest importance to the thinker himself. Dobzhansky begins his book with a remark about Dostoevsky. "Dostoevsky makes his Ivan Karamazov declare: 'What is strange, what is marvelous, is not that God really exists, the marvel is that such an idea, the idea of the necessity of God, could have entered the head of such a savage and vicious beast as man; so holy it is, so moving, so wise, and such a great honor it does to man.'" Two pages later, Dobzhansky states that "it is the ultimate concern in man that Ivan Karamazov found so strange and so marvelous. Man's nature impels him to ask the Big Questions. Every individual makes some attempts to answer them at least to his own satisfaction." This volume will be of great interest to biologists who admire Dobzhansky's work in his own field and who will be curious to see where he is led by his incursions into others. The author expresses himself as being obligated in his thinking to Arnold Toynbee, among others. I would venture to predict that this book will be especially well received by readers who share Dobzhansky's admiration of Toynbee.

Dr. Oppenheimer is Professor of Biology at Bryn Mawr. Among her main interests are experimental embryology and the history of biology and medicine.

MAN-APES OR APE-MEN? by Sir Wi
frid E. Le Gros Clark. *Holt, Rinehar*
and Winston, $3.95; 150 pp., illus.

THE author of this volume, Emeritu
Professor of Anatomy at Oxford, i
one of the most distinguished student
of human evolution. His share in re
vealing the Piltdown fraud in 1953 i
well known, and he has long taken
leading part in interpreting those mos
valuable hominids of the earlier Pleis
tocene, the australopithecines. In thi
compact and well-organized book h
presents the distillation of his thought
on these creatures, whom he consider
ancestral to man, and on the controver
sies that have surrounded them sinc
1925, when Dart made his celebrate
announcement.

The initial debate over whether the
were primitive hominids or merely un
usual apes was settled long ago. A
the present time the main argument
center around their taxonomic statu
and the relationships of the differen
australopithecine finds to each other
Le Gros Clark comes down firmly o
the side of the lumpers, rather than o
the splitters, and presents his reason
for believing that all the early Pleisto
cene hominids so far known in Afric
can be considered australopithecines-
widely ranging and by no means identi
cal groups of local populations, bu
nevertheless all assignable to Austra
lopithecinae. He chides some of hi
colleagues for failing to take grou
variability sufficiently into account, fo
their tendency to exaggerate anatomi
cal details that in his opinion ar
trivial or irrelevant, and for the lament
able habit among many of creating ne
and unnecessary names for their favo
ite fossils.

Probably none of the specialist
working in this field today will fail t
disagree with one or more of Sir Wi
frid's points. He rejects the recent cre
ation of the *Homo habilis* category b
Leakey and his colleagues and doubt
the reality of Robinson's *Homo erectu*
(ex-*Telanthropus*) at Swartkrans. Un
like several authorities today, he is no
prepared to consider the australopithe
cines as members of the genus *Homo*
He is also dubious about the claims fo
australopithecines in the Far East. H
willingly agrees that the australopithe
cines were tool-users and tool-maker
but is justifiably cautious about Dart
"bone-tooth-horn culture." His opin
ions are presented in a firm but alway
fair and undogmatic fashion, and h
ideas are well expressed, using neithe
jargon nor condescension. The book
highly readable for students, for pro
fessional anthropologists, and for la
men who want a clear but authoritati
view of the present confused situatio
The illustrations, both line drawing

photographs, are good and there is lpful bibliography. A chronological le and a map of the sites discussed ld have been useful.

PHILIP E. L. SMITH
Université de Montréal

E SHOSHONEANS, text by Edward n, photographs by Leroy Lucas. *liam Morrow and Co., $6.95; 96 pp.,* s. THIS LAND WAS THEIRS, by Wen- H. Oswalt. *John Wiley & Sons,* *5; 560 pp.*

CK HURLEY, the completely professional boxing manager, once aned, "God deliver me from ama- s." I don't recall the events that ng this plea for divine aid from the mally hard-bitten fight manager, after reading *The Shoshoneans,* I k I know how Hurley felt. Dorn's has everything. Profound observa- : "Everything in Nevada, we no- , as we go through it is nonexis- ." Sensationalism: "You won't eve this—there are towns in Nevada ch have no dime stores!" Beauti- y garbled summaries of scientific ries: "Morris Swadesh, the lin- t, by attention to the glottis, the e between the vocal cords, has es- ted the time between the cleavage anguages. The languages of this inent seem reduced to three. It ht in the end be one art. It may al- ly be one articulation." No one will n much by reading Dorn's text, but reader who is in the mood for a nonsense can have a good time.

esides, the text is clearly meant to ncidental to the principal part of book, several dozen photographs by y Lucas. To some extent, Lucas caught up in the fun and games. shows us pictures of a junk yard, a line pump, a movie theater in lock, Nevada, a sign advertising 's Auto Sales, and a poster urging te for William Henry Harrison for gress. However, when Lucas turns amera on the Indians, he gives us sensitive studies of Indian faces some interesting shots of modern an ceremonies. The series of os on the Sun Dance is particularly worthy. It is a shame that none e pictures have captions, for they not self-explanatory. How is the ral reader to know that the Indians d around a blanket beating time ooden poles are playing a gamb- game known as the "hand game"? *e Shoshoneans* could have been a l book. Lucas and Dorn want to ent an honest and sympathetic pic- of the Indians, and they have done est they can. But the text is aim- and silly. The lack of the normal for the reader—an adequate table ntents, a list of illustrations, cap-

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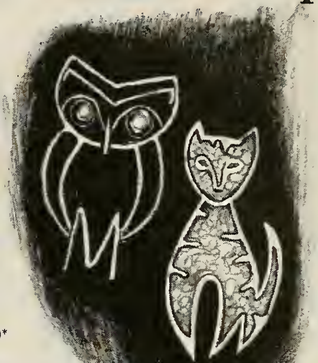

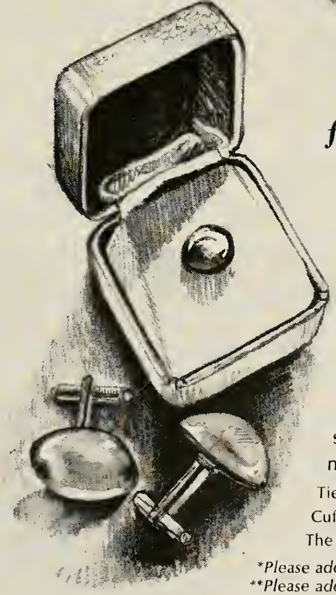

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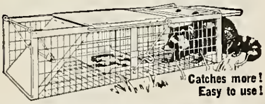
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tions, and an index—gives the book a negligent air. For carelessly produced books such as this one, the publishers bear a major responsibility.

This Land Was Theirs, by Wendell H. Oswalt, is a different kind of book altogether. Oswalt seeks to instruct, rather than to create a mood, and the book appears to be designed for college classes in North American ethnology rather than for a general audience. It consists principally of brief ethnographies and histories of ten tribes scattered over the United States and Canada. The tribes are selected to represent various culture areas. There are the familiar Hopi of the Southwest, the Iroquois of the Eastern Woodlands, and the Tlingit of the Pacific Northwest, plus a few tribes that are not nearly so well known to the general public: principally, the Cahuilla of the southern California desert, the Beothuk of Newfoundland, and the Natchez of the lower Mississippi River.

The book has a few noteworthy features. History and ethnography are combined to a greater extent than is usual in similar books. The maps are excellent. The most useful feature of the book is the final chapter, which discusses various topics that are fundamental to our understanding of the place of the Indians in modern American society: What an Indian is (legally), Indian status regarding citizenship, population, urbanization, major legislation affecting Indians, and current governmental policies.

The book has one principal defect. Aside from the maps, it has no illustrations. It is impossible to present ethnography in any meaningful way without the use of illustrations. How can the reader possibly know what a Plains Indian parfleche or a Northwest Coast halibut hook look like? Oswalt might imagine the difficulty he probably would have in reading a college level text on, say, invertebrates that contained no drawings or photographs. Despite the author's painstaking scholarship, *This Land Was Theirs* is just another book about Indians. It fills no major gap in the literature, and it does its job no better than other, similar books. But substantially the same text with two or three hundred high-quality drawings and photographs would be a genuine contribution.

STANLEY A. FREED
The American Museum

BIOLOGICAL TECHNIQUES, by Jens W. Knudsen. *Harper & Row, $12.00; 525 pp., illus.*

IT is often a simple thing to collect a common plant or animal, but what to do with it, how to preserve it, and how to prepare it for study can be quite another matter. *Biological T* *niques* is a compendium that outli in general terms the methods of lo ing, collecting, preserving, curati displaying, and illustrating represe tives of the biotic world, and some the problems encountered when deavoring to accomplish these e This volume will be welcomed by m students of natural history who de an introduction to the many facet biological techniques.

For the sake of convenience, book may be divided into five pa which cover—after the initial cha on introductory techniques and lecting sites—plants, invertebrates protochordates, vertebrates, scien illustration, and four appendixes deal with display methods, slide n ing, reagents and solutions, and cotizing agents. Each of the chap is designed to be a complete unit, cluding bibliography, on the grou related groups covered.

To properly judge this book, must know for whom it is inten The author claims that it was wri “. . . for courses in biological t niques or museum techniques, an meet the needs of those who are volved in working with natural his material.” Unfortunately, it falls s what short of its intended mar seemingly inherent quality in m ambitious undertakings of this nat Indeed, the reader will find many a in great need of revisions, additi and more detailed treatment.

There are, moreover, a few m criticisms to be noted. The first perhaps most important one is tha a few of the procedures outlined too superficial to be of much valu the specialist, and these instruct may well lead the novice to virtu useless preparations. Of equal im tance are the decidedly large gap the literature cited, obviously an portant aspect of any book of nature. Such basic references as staffe and Fidler's 200-page boo invertebrates, *The Preservation* *Natural History Specimens*, *ZoB* *Marine Microbiology*, the Amer Malacological Union's handbook *How to Collect Shells*, Ridgway's *entific Illustration*, and Zweifel *Handbook of Biological Illustratio* just a few of the many valuable sou of information that should have cited and included in one of the lis references.

It should be emphasized that text is definitely not the ultimate sc for the serious student of a parti animal or plant group, who will have to resort to searching throug primary literature. And, in the vein, this book is not intended fo museum worker interested in pr ing public displays.

he author would have been well
ised to add a chapter or biblio-
phic appendix on photographic
hods, and perhaps a bibliography
ome of the journals that not infre-
ntly carry articles along the lines
out in this book. One of the many
ı journals is The American Mu-
m of Natural History's *Curator*.

lthough this book has some limita-
s, these will not impair its value
general reference purposes, espe-
ly for beginners and for many
anced students of natural history
desire information in areas other
ı their specialty. This volume is also
elcome companion to the recently
lished, multiauthored *Handbook of*
eontological Techniques.

ARNOLD ROSS
The American Museum

N AND PANDAS, by Ramona and Des-
ıd Morris. *McGraw-Hill Book Co.,*
5; 223 pp., illus. THE WORLD OF
POLAR BEAR, by Richard Perry.
versity of Washington Press, $4.95;
pp., illus.

LTHOUGH the zoo-based panda and
the wild polar bear of these two
ks are very different, they both have
rmous human appeal.

Men and Pandas is an intriguing account with many photographs. Not "discovered" by scientists until 1869, pandas are still a rarity outside of their home in central Asia. The few that reached the United States are now dead, and the Chinese political situation prevents us from getting more.

Is the panda a bear or a raccoon? This controversy of many years is related, blow by blow, and the learned authorities for each side are named. The authors conclude facetiously that this bamboo eater (panda) is more like the "old time bamboo eater newly giantized than an old time giant recently bamboozled"!

The book describes the animal largely from the history of zoo specimens, beginning with the capture of the famous Su-Lin by Mrs. Ruth Harkness in 1936. Only two pandas have been bred in captivity—both in Peking. As recently as 1966, millions of newspaper readers followed the unsuccessful "love affair" of London's female Chi-Chi who was flown to Moscow but would only engage in a snarling match with An-An, one of Russia's two male pandas.

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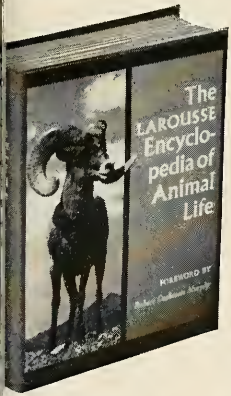

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ships, and panda physical maintenance. Desmond Morris is the Curator of Mammals for the Zoological Society of London. which operates the London and Whipsnade Zoos. Interesting appendixes. a bibliography of nearly 150 titles. and an index complete the book.

The World of the Polar Bear is a more sober, and more exciting, book. To summarize the comparatively little that is known about the polar bear. the author has combed natural histories, reports. diaries, and journals, as well as literature on polar explorations. He traces the earliest records of the polar bear from the first century A.D. through Eric the Red and Marco Polo to present times.

The result is a remarkable collection of experiences relating the life history of the polar bear from birth to death; its travels. cleverness. courage. and curiosity. Many pages are devoted to seals (the bear's most important food), the bear's skill in hunting them. and its relations with the walrus.

Is the bear dangerous to man? Perry examines the horrendous accounts of bear attacks, provoked and unprovoked. over the centuries and decides that today, unless man is mistaken for a seal. the polar bear is seldom a threat.

In analyzing the present status and probable future of this mammal hunted by plane. on land. and at sea, the author is concerned that the few protective measures taken by some polar countries may be too little. too late.

Richard Perry, the author, trained in zoology at Cambridge University, is a professional writer. an indefatigable researcher. and a dedicated conservationist. He includes in his book a dozen excellent photographs. an index, a valuable bibliography, and a map.

VICTOR H. CAHALANE
Zoologist and Author

BEYOND THE OBSERVATORY, by Harlow Shapley. *Charles Scribner's Sons, $4.50; 222 pp.*

For a long time Harlow Shapley's lectures have educated, entertained, and emancipated the minds of countless teen-age enthusiasts. amateur astronomers. serious students. and professional astronomers; this reviewer has successively represented each of these categories and still cherishes any opportunity to hear his thoughts. Dr. Shapley writes in the manner that he speaks—a style that is informal. colorful. and compelling.

The collection of eleven essays presented in *Beyond the Observatory* is primarily an outgrowth and development of ideas dealt with in the author's lectures to non-astronomers in recent years. The subjects. as the title indicates, go beyond the realm of astronomy. They touch on almost all scientific
subjects and social problems faci
man today as Dr. Shapley permits
latent ideas in his highly imaginat
mind to rise to the surface of rec
nition and fuse into something t
strikes him as being worthy of ful
explanation to himself and others.

His discussion of the chemical e
ment argon throughout the ages
earth is such a subject. Argon, the
that makes up one per cent of our
mosphere, shuns all association w
atoms of other elements. thus rema
ing aloof in our atmosphere since
beginnings. in contrast to the nitro
and oxygen atoms—the main const
ents of the atmosphere—which are c
tinually being exchanged with th
previously locked up in gaseous
solid molecules. But argon atoms ha
individually, always been a part of
atmosphere; the author traces th
through history in amusing detail e
as they are inhaled and exhaled
famous persons from the past.

Dr. Shapley lets his mind soar ab
and about the ideas connected with
latest scientific discoveries. and ar
ipates further discoveries. In gene
this sort of beyond-the-fringe think
can lead to the early obsolescence
a book. In this case. the reader
not be bothered by this, as it is the
of thinking and the presentation
stimulate the reader, and much of w
Dr. Shapley says is sound reasonin

In the preface, the author admit
some overlap in the eleven essays;
does no harm, particularly if the rea
follows the advice of this revie
namely. to spread the reading of th
little gems of thought over at l
eleven nights and to permit some t
during each day to savor, enjoy,
speculate upon the ideas that the
thor casts in rapid succession. Be
faithful to his prime, lifelong pro
sion, Dr. Shapley has provided a
ning thread of astronomy in this b
that would warrant its inclusion in
astronomy collection. but the vol
is general enough so that the rea
wishing to broaden the scope of
science library will also want to ow

SARAH LEE LIPPINC
Swarthmore Co

PEARY: THE EXPLORER AND THE N
by John Edward Weems. *Houg
Mifflin Co., $6.95; 362 pp., illus.*

Now that flights over the North
are a daily occurrence, it se
almost impossible to understand
excitement that surrounded its "
covery" in 1909. There is. after
nothing there to discover—only
imaginary point in an ice-choked o
—but in those romantic days nati
prestige was at issue. President T
dore Roosevelt had written to R
E. Peary, "I believe that you are d
most admirable work for America

setting an example to the young of our day which we need to have amid the softening tendencies of time."

eary was a typical explorer of his , a man driven by hunger for fame convinced that he had been tapped destiny. He believed that the nerican" route, between Canada Greenland, belonged to him and no one had a right to use it without permission. He was a loner, raised a doting mother after his father's th before he was three; a civil engi- in the Navy, where his popularity the establishment ranked some- t low; and, when he finally did h the pole, he was fifty-two. In t, he was just the sort of person would be eliminated in the first ening for the vast governmental ntific exploration organizations of y. His character and achievements t, however, be judged in the con- of his own time.

his new biography is an intro- tion to such a study. It is short sometimes superficial, composed ely of quotations from letters, ies, and other memorabilia spliced ther with bits of background. It is able because the author had access e vast collection of papers amassed Peary and his family (who appar- y saved everything)—papers that not yet been made public. These ers are destined to be placed in National Archives; when they are, e will doubtless be definitive stud- of Peary and his times, studies to h this book is but the preface.

DAVID LINTON
Polar Photographer-Writer

BIRDS OF TIKAL, by Frank B. the. *Natural History Press, $7.50; pp., illus.*

OSE of us who cross the border into Mexico looking for birds have been ght up on guides in which every is illustrated, and we are shocked d there is no such guide to help us h of the border. The continued and ntable absence of a color-illus- d field guide to Mexican birds has been a source of annoyance to thologists, and Frank Smithe's will at least go partway to fill this While Tikal is in Guatemala, not ico, its avifauna is so close to that djacent Mexico that only three s are present at Tikal that are not d in Mexico. Smithe's book con- illustrations of 107 species of s, all of which were specially se- d because they have not been il- ated before (which is often the) or because they are hard to tify in the field. Having strug- with unillustrated field guides in ico recently, I was delighted to see,

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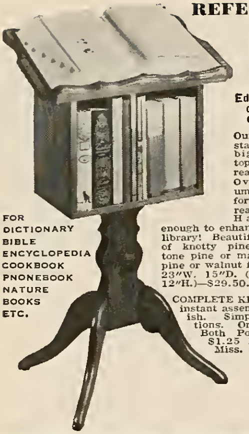

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for instance, a plate showing both males and females of the similar-looking Red-crowned and Red-throated Ant-Tanagers.

The illustrations themselves are first class, and H. Wayne Trimm is to be congratulated on a fine job. Reproduction of the plates is excellent.

I mention the book's usefulness in Mexico first, because I suspect its greatest sales will be among those wanting to see pictures of at least some Mexican species. But the book is much more than a supplemental Mexican guide, and that is not its intent. Its purpose, as the author tells us, is to aid visitors to Tikal to identify the many birds they see there, and to tell a little about them. This book should go far to satisfy their curiosity.

At Tikal, 281 species of birds have occurred, and these are fully treated in the text. Descriptions of each bird are given, together with information on voice, nest, eggs, and habits. While the style of the text tends at times to be somewhat rambling and anecdotal, it is always interesting. The book goes far beyond its avowed intent of enabling visitors to identify the birds at Tikal, and includes a wealth of information on many of the tropical lowland forest birds of Central America. A useful feature is the list of references given at the end of the discussion of each species telling where additional information can be found. An introduction gives the biological and historical background to Tikal, and there are two useful maps.

My main criticism of the book is that the author did not go on to finish the job he started so well, namely, to illustrate all the birds of the area.

However, this is an excellent book both for the ordinary visitor to Tikal and for the professional ornithologist, who will find it a significant contribution to Central American ornithology.

G. STUART KEITH
The American Museum

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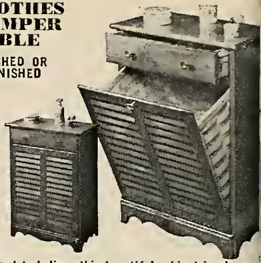

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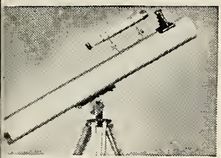

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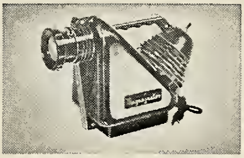

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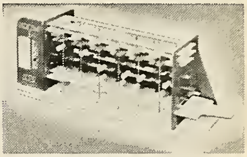

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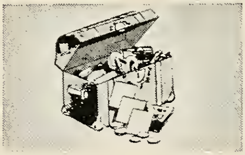

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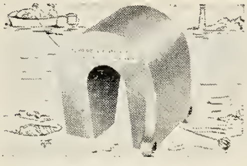

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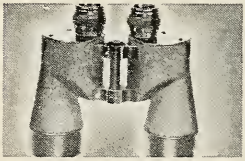

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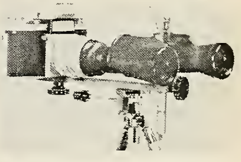

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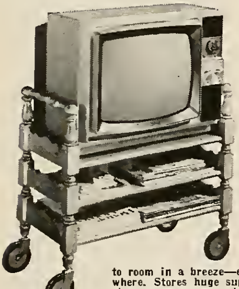

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The Idiot. F. Dostoyevski. E. P. Dutton & Co.. Inc., New York & London.

Ward No. 6. A. Chekhov. Great Russian Short Novels, edited by P. Rahv, The Dial Press, New York, 1951.

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A CONSEQUENCE OF TOGETHERNESS

The Wolves of Mount McKinley. A. Murie. U.S. Government Printing Office, Washington, D.C., 1944.

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The Bighorn of Death Valley. R. E. Welles and F. B. Welles. U.S. Government Printing Office, Washington, D.C., 1961.

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Field Guide to Rocky Mountain Wildflowers. J. J. Craighead, F. C. Craighead, Jr., and R. J. Davis. The Riverside Press, Cambridge, 1963.

A Guide to the Craters of the Moon National Monument, Idaho. Harold T. Stearns. Caxton Printers, Ltd., Caldwell, 1930.

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Morphology, Behavior and Reproduction in Type A and Type B of Chaos chaos Linnaeus, the Giant Amoeba of Roesel. A. A. Schaeffer. *Biology Bulletin*, Vol. 73, page 355, 1937.

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Pelomyxa carolinensis: General Observations on the Illinois Stock. R. R. Kudo. *Journal of Morphology*, Vol. 78, page 317, 1946.

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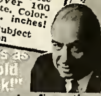

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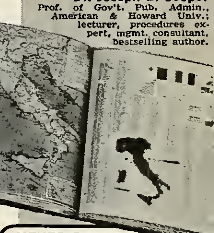

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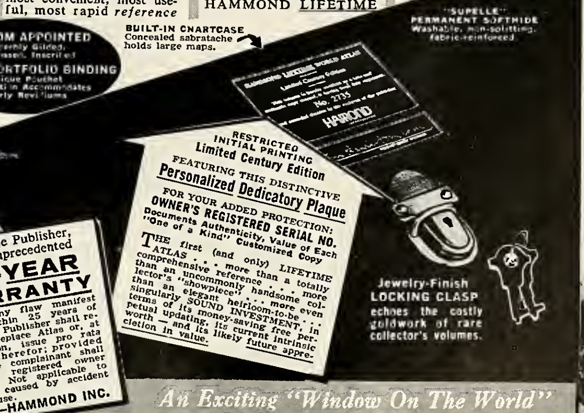

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Antarctica

The article entitled "Antarctica" by Dr. Robert Cushman Murphy that appeared in the June-July, 1967, issue of your magazine was, in my opinion, an outstanding contribution to the conservation of Antarctica.

Dr. Murphy has brought to the attention of your readers the paramount needs of conservation on the White Continent. As a veteran of three Antarctic expeditions, I have long advocated a tolerance for wildlife within the Antarctic Circle, and I have been aware of the traumatic consequences of the excessive banding and wing-marking upon *Pygoscelis* [Adélie Penguin]. I am hopeful that the conservation measures in the Antarctic will be enforced.

Malcolm Davis
Consulting Biologist
National Wildlife Federation
Washington, D. C.

The Park

I don't think there is any serious danger of the encroachments the article ["The Park," August-September, Natural History] stresses. I do think crazy stunts, disorder, and litter will ruin the park system if not controlled. Some of the logic, if it is logic, of the article baffles me. Why heave a rock at Jamaica Bay which, by the way, is by no means inaccessible?

Robert Moses
Chairman, Triborough Bridge
and Tunnel Authority
(Parks Commissioner of
New York City, 1934-1960)

I am grateful to Mr. Jack Hope for his lively handling of a serious and troubling subject in his article "The Park" in the August-September issue of Natural History. The war to preserve open space in cities is continuing and unending. Recently the National Recreation and Park Association passed a resolution calling for a national crusade to end park encroachment. Mr. Hope's article and the illustration of the partial list of "improvements" suggested for Central Park since its inception provide fine weapons for this crusade.

I am glad Mr. Hope pointed out there are no biologists in the New York City Department of Parks. I had recommended over a period of years that the parks themselves be under the supervision of an ecologist and that the central staff consist of biologists, botanists, horticulturists, and conservationists. I have also urged that an advisory committee be constituted for the park system which would include representation from the major conservation organizations in the city and from the New York Zoological Society and the various botanical gardens.

I was interested in his discussion of waste disposal, which remains a major problem in all cities. The Planning Commission presently is studying this matter, and the comprehensive plan for the city will include recommendations that may help to protect marshland and natural drainage areas.

The only quarrel I have with Mr. Hope is the implied criticism of recreation and cultural affairs as part of the predominant operation within parks. I believe that a good recreation and cultural affairs program would protect and use the open space and park lands correctly. I further believe the Jamaica Bay Wildlife Refuge could be developed in such a way as to safeguard existing areas and at the same time enable more people in the city to enjoy this contact with our natural environment.

Study of nature is one of the most important parts of a good recreation program. Such programs *are* important if the education which the article proposes is to be effective, so that there will be a large constituency for the concept of natural open space. The use of parks for meaningful recreation programs makes them safe, and fulfills important goals for the health, welfare, and education of our citizens.

I hope you will continue to bring us more articles like this one. The bulldozed hill, the uprooted tree, and the burned-out underbrush are never replaced. Once we have lost the few remaining bits and scraps of natural areas that remain in our city,
once we have destroyed the ani
and plant life and the places for
grating birds, there will be no pl
left for the exploring child to to
and see the world, and no places
adults to find refreshment, insp
tion, and peace. If we destroy
souls of our children, we destroy
world, and if we destroy the nat
world we do effectively destroy
souls of our children.

Elinor C. Guggenhei
Commissic
New York City Planning Commis

We were glad to learn that the
York City Parks Department has
cently engaged the Philadelphia f
of Wallace, McHarg, Roberts
Todd to conduct an ecologic sur
of Staten Island. Parks Departm
lands on the island constitute on
the few locations within the
where the natural environment
mains relatively intact.

The results of the Staten Isl
survey remain to be seen. Ed.

Sable Island

A scant two days after we ma
our August-September issue,
photograph below appeared in
New York Times financial sect
fulfilling author Fred Bruemm
prediction of the future of S
Island. Ed.

e Hasselblad EL could be one of the most important research tools you ever buy.

evious advertisements we discussed the many and va- applications for which the elblad System can be used e scientific and industrial . We would now like to dis- a unique combination of elblad components and of the rather unique appli- ns to which they can be

camera in question is the elblad EL, an electrically n 2¼" square, single lens, camera, powered by one vo rechargeable batteries, battery good for 1000 ex- res on a single charge. The is wound on and the shut- ocked automatically after exposure. Exposures can ade manually or by remote rol, using either long re- cables or a radio release.

asselblad EL accepts prac- y all the accessories that vailable for the Hasselblad (the standard body in the asselblad System), includ- he 120-12 exposure maga- the 220-24 exposure maga- and, of particular interest the EL, the 70mm-70 expo- magazine. The Hasselblad so accepts all seven lenses ble in the Hasselblad Sys- from the extreme wide Zeiss Distagon of 40mm length, 88° angle of view, aximum aperture f/4, to eiss Tele-Tessar of 500mm length, 9° angle of view, mum aperture f/8.

d below are five particular iverse applications for the

ral Instrument Recording

Hasselblad EL cameras lready proving their worth, dustrial and research insti- s all over the world, as ding devices for the constant surveillance of instrument banks and oscilloscope screens on a 24 hour basis.

By the use of the EL with a lens of the appropriate focal length, and the 70 exposure 70mm film magazine, banks of cameras, using the Hasselblad remote control timer, can make a number of exposures between 2 and 60 intervals for each of 3 time ranges—seconds, minutes or hours.

Thus, many valuable man hours can be saved which would otherwise be wasted making manual photographic records.

Hydraulic Engineering and Fluid Flow Research

The Hasselblad EL is particularly suited to many forms of fluid flow research and in the solving of river current and flow location problems. Banks of up to 20 Hasselblad ELs are suspended over a scale model of the river bed or sections of the ocean floor to be studied. By floating numbers of white polystyrene balls down the model and illuminating them by mercury vapor lamps, a series of tracks is formed on the negatives against the black of the river bed. By computing the distance of the tracks against a speed scale included in the photograph, flow speeds can be calculated.

By using much smaller plastic chips and the same photographic techniques, current patterns are formed at mouths of rivers, in bays and around structures in the river.

Obviously, the remote control features of the Hasselblad make it extremely useful for this kind of work, and the use of either the 70mm-70 exposure, or 220-24 exposure magazine, allows the researcher to make many exposures before bringing the camera down from the roof of the building. And, unless the building has an extremely high roof, (in which case the 80mm-Planar could be used) the 40mm Distagon will allow the maximum area to be covered by each camera.

Materials Testing

Other than the more regular forms of material testing which are usually carried out under ideal laboratory conditions, there are certain times when photographs of fractures or breakages of materials are needed. Yet, the structures are inaccessible to a photographer e.g., the inspection of blast furnaces or large capacity wine storage casks, both containing large quantities of toxic gas. In these instances, the lowering of the EL into the structures to be tested and the operation of the camera by remote control, provides the solution to the problem. Once again, the use of the 70mm magazine is desirable if numerous exposures are required.

Because of the confined space of the structures, the wide angle lenses available for the Hasselblad, the 40mm Distagon, with its 88° angle of view, or the 50mm Distagon, with its 75° angle of view, would be most useful.

Cave Photography & Speleology

A great deal of photography in cave and cavern research and its related sciences, palaeontology, anthropology and prehistory, is being done with the Hasselblad EL.

Working conditions are usually so bad—mud, water and of course, constant darkness—that film changes are not only undesirable but usually impossible. Use of either the 220-24 exposure or the 70mm-70 exposure magazine will reduce the number of film changes to the absolute minimum. Because of the spacial limitations of a cave, a wide angle lens is indispensable. Either the 40mm Distagon, with its 88° angle of view, or the 50mm Distagon, with its 75° angle of view, cannot be bettered.

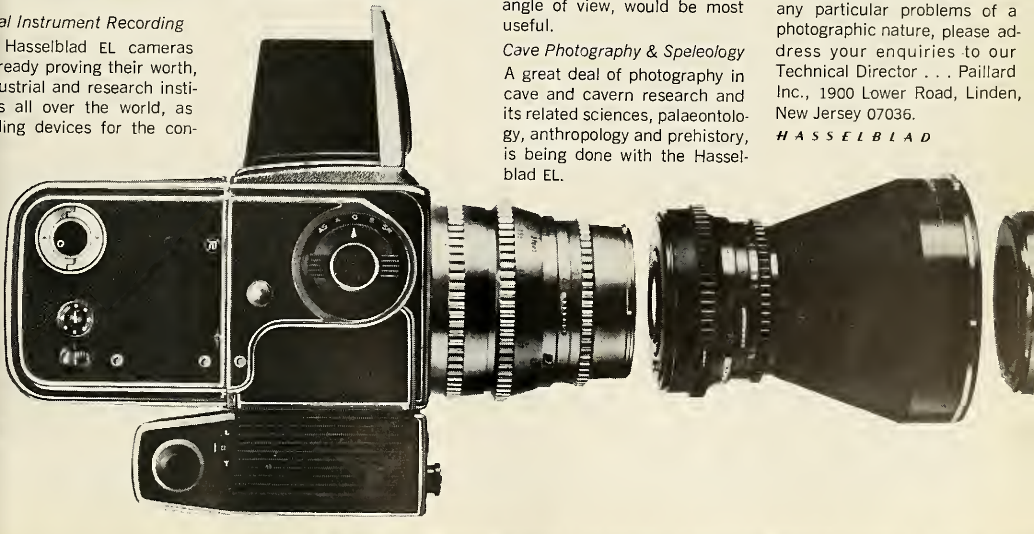
Aerial Photography

The Hasselblad EL is also ideally suited for many phases of aeronautical research. In most aerial research photography the camera is not handled by a skilled photographer, but usually by a flight test engineer or even, in the case of a single seat airplane, by the pilot himself. These people do not have the time to be concerned with manual operations such as exposing, winding on or changing film.

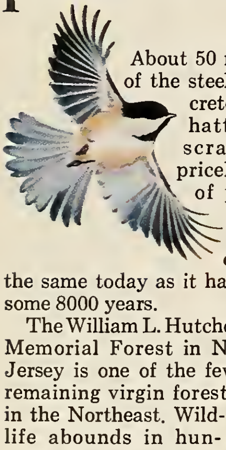
Flight instrumentation recording by remote control operation of the pre-focused Hasselblad EL allows for the reconstruction of flight conditions at pre-determined intervals during the test flights.

Numerous accessories are available for the Hasselblad EL. These are fully outlined in a 40 page illustrated booklet which we would be happy to send to you on request. If you also have any particular problems of a photographic nature, please address your enquiries to our Technical Director . . . Paillard Inc., 1900 Lower Road, Linden, New Jersey 07036.

HASSELBLAD



How a labor union and a university helpe preserve a natural woodland treasure.

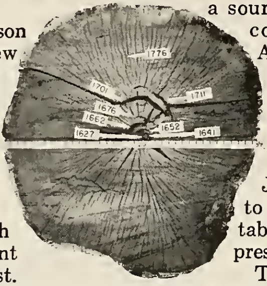


About 50 miles west of the steel and concrete of Manhattan's skyscrapers is a priceless patch of primitive America that is essentially the same today as it has been for some 8000 years.

The William L. Hutcheson Memorial Forest in New Jersey is one of the few remaining virgin forests in the Northeast. Wildlife abounds in hundreds of species. Below ground is a fantastic world of insects and microscopic organisms, each playing its own important role in the life of the forest.

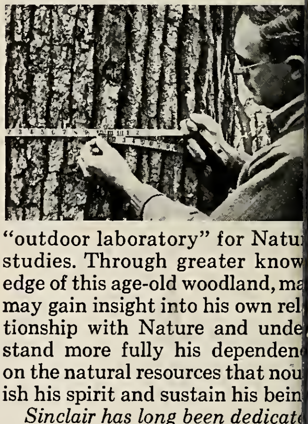
Nature has been working for thousands of years to perfect this "climax" community in which trees, plants, animals and all the creatures of the forest have reached a state of harmonious balance with their environment. Left undisturbed, this stabilized society will continue to perpetuate itself century after century.

In 1955, Thomas Mettler, whose family had owned the property since 1701, was urged to sell it as a source of timber for commercial use. Aware of its unique value, Mettler held off on the sale until public-spirited residents of New Jersey had time to organize and establish it as a forest preserve.



Thanks to the help of private individuals and groups, including members of the United Brotherhood of Carpenters and Joiners, the forest was eventually purchased and named in honor of William L. Hutcheson, a past President of the Union.

Under the direction of Rutgers University, the forest is used as an



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Natural History

The rocks below are red and brown, set in deep shadows, but above, they are buff and vermilion, and stand in the sunshine. The light above, made more brilliant by the bright-tinted rocks, and the shadows below more gloomy by the somber hues of the brown walls, increase the apparent depths of the cañons, and it seems a long way up to the world of... open sky, and a long way down to the bottom of the cañon glooms.

John Wesley Powell

Bolex H-16 cine syst

For some time now Bolex has been making and selling (at ¼ to ⅓ less than any one else) the best professional 16mm cine system you can buy.

ONE MAN OPERATION.—Bolex H-16 cameras have become famous for their ruggedness, dependability, quality optics and light weight, making them perfect for one man (Fig. 1) filming operations and eliminating the need for any kind of back-up crew.

FIG. 1

FILM CAPACITY.—The only thing that Bolex H-16 cameras could be faulted on was that they only had a 100 ft. film capacity.

400 FT. MAGAZINE.—That's why we introduced the Bolex 400 ft. film magazine to fit both the H-16 REX-5 and the H-16 M-5 in the Bolex H-16 cine system.

SYNCHRONIZATION.—Used with the new constant speed motor (24 FPS) with sync output for lip-sync on ¼ inch tape and automatic built in clap-stick for easy synchronization, the 400 ft. magazine with either the H-16 REX-5 or the H-16 M-5, offers the professional user in any branch of movie production, science, industry or education unlimited versatility and scope.

THE TWO BASIC CAMERAS.—The H-16 REX-5 is a three lens turret camera that offers reflex viewing and focusing on ground glass, allowing the photographer complete control of composition, framing and correct evaluation of depth of field. The H-16 M-5, built with economy in mind, is a single lens camera with viewing through a removable optical finder mounted on the side of the camera. The H-16 M-5 takes all standard "C" mount lenses or Pan Cinor and Angenieux zoom lenses, both equipped with reflex viewing and focusing.

LENSES AND ACCESSORIES.—There are 10 fixed focal length lenses from 10mm to 150mm in the H-16 system, and 7 zoom lenses giving a wide range of zooming ratios from 5 to 1 up to 10 to 1, including the Vario Switar 86EE, the world's first and only fully automatic 16mm variable focal length lens, with zoom from 18 to 86mm. Many accessories are available in the H-16 system including motors, close-up attachments, grips, matte box, titler, light meter, carrying cases and both optical sound and optical/magnetic sound projectors.

MANY APPLICATIONS.—Because of its ruggedness, compactness and light weight a single operator can use the Bolex H-16 system for any of the following applications:

Sports filming, including coaching and training films, for club and school use.
Medical photography, surgical and research filming, Cinephotomicrography.
Advertising, promotion and TV work for both studio and location shooting.
Travel and educational filming.
Wild life and nature photography.
Amateur film making.
Industrial filming, including training, recording, research and work study films.
Memomotion and traffic flow studies.
Periodic industrial data recording.
Underwater filming, (with housing).
Time lapse studies.
Remote control filming.
Instrumentation recording.
All types of sound work.

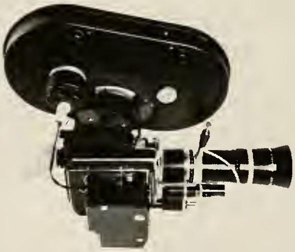

FIG. 2

The H-16 REX-5 camera (Fig. 2), with 400 ft. magazine, 24 FPS constant speed motor, detachable take-up motor on magazine eliminating the use of old fashioned take-up belts. The H-16 REX-5 offers reflex viewing and focusing on ground glass. Variable shutter. Filter slot. Accurate automatic dual frame counters and registrator claw for picture steadiness.

Shown on the camera is a Vario Switar 86EE zoom lens with automatic exposure control and a zoom range of 18 to 86mm. Maximum aperture f/2.5.

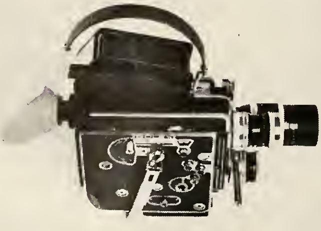

FIG. 3

The H-16 REX-5 (Fig. 3) shown
out 400 ft. magazine. The camera take
ft. film loads and has all of the tradit
Bolex features such as filter slot, var
shutter for fades, dissolves and greate
posure control, automatic loading and
vision to accept the 400 ft. magazi
desired. Lenses shown are Switar 1
f/1.6, 25mm f/1.4, 75mm f/1.9.

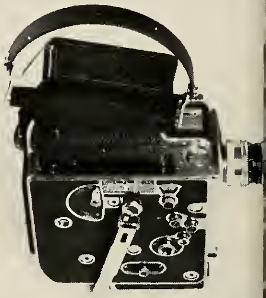

FIG. 4

The Bolex H-16 M-5 (Fig. 4), wit
gle lens mount, an extremely econor
professional quality 16mm camera equ
with such features as variable speeds,
frame shooting, footage and frame co
unlimited film rewind and auton
threading.

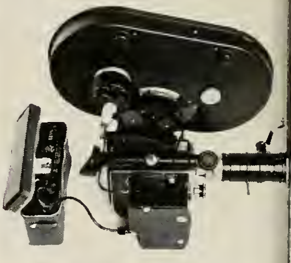

FIG. 5

The H-16 M-5 (Fig. 5) can also be
in conjunction with the 400 ft. magazi
FPS constant speed motor and rech
able battery pack. This is an ideal
for sports filming where a large film c
ity is desirable to avoid loss of action fo

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Natural History

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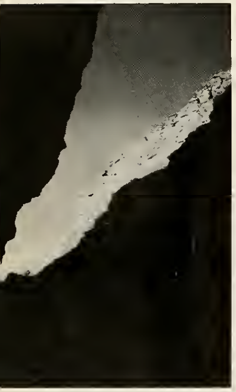
Anthony J. Wiener and Herman Kahn

Some forward-looking sections selected from "The Year 2000: A Framework for Speculation on the Next Thirty-three Years," published this fall by The Macmillan Co., discuss man's probable future ecological predicament.

TRANCE CURE OF THE !KUNG BUSHMEN 30
Richard B. Lee

A magical ritual cures the sick and unites the members of this hunting and gathering tribe of southern Africa's Kalahari Desert in a common front against the external sources of malevolence that threaten them.



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The significance and beauty of one of America's most notable and controversial resources are interpreted by an eminent man of the theater, a geologist, and two photographers, Patricia Caulfield and Ansel Adams (cover).

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John D. Palmer

The irresistible urge of many animals to orient themselves with the earth's magnetic field is a demonstrable fact—a fact that may play a significant role in the migration flights of birds.

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The social behavior of the plains zebra stallion often leads to intensive and spectacular battles.

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MARK OF EXCELLENCE

THE AUTHORS

Herman Kahn *Anthony J. Wiener*

Richard B. Lee

Brooks Atkinson

William J. Breed

John D. Palmer

Richard D. Estes

ANTHONY J. WIENER and HERMAN KAHN are specialists in the fields of science and public policy at the Hudson Institute. Mr. Wiener is a lawyer and social scientist whose studies at the Institute include international crises, European political and military positions, U.S. poverty and race relations, arms control, and other issues concerning the political, sociological, and psychological aspects of public policy problems. Previously associated with Arthur D. Little. Inc., Wiener has also served as an instructor at Massachusetts Institute of Technology, and Research Fellow of the Society for the Investigation of Human Ecology. Physicist Herman Kahn is Director and principal founder of the Hudson Institute. He is a major consultant for the U.S. government and for numerous scientific and industrial concerns. Formerly with the RAND Corporation, Kahn has published widely and has lectured throughout the world. The authors are grateful to MORTON A. KAPLAN, of the Institute and the University of Chicago, for contributions to portions of their discussion.

Few primitive peoples are so classic an example of the hunting-gathering way of life as the Bushman tribes of the Kalahari Desert. RICHARD B. LEE's interest in the ecology and culture of hunter-gatherers took him to Africa for seventeen months, beginning in 1963, to do basic work for his Ph.D. After receiving his doctorate from the University of California at Berkeley in 1965 (his earlier schooling was at the University of Toronto), Dr. Lee spent a year as Lecturer in Social Anthropology at Harvard. He is presently back in the Kalahari for further ethnological studies of the Bushmen. Dr. Lee's wife, Nancy, who is a sociologist, accompanied her husband and is engaged in demographic studies of the !Kung tribe.

BROOKS ATKINSON was drama critic at *The New York Times* some thirty-five years, interrupted only by stints as a war correspondent in China and Russia during World War II. In 1960 he retired as drama critic to write a "Critic at Large" colum His love for the theater is whol equalled by his love for the out- doors, as evidenced by his passi for bird watching and a series books and essays stringing back 1925, when Knopf published *Skyli Promenades*, Atkinson's reflectio on mountains and mountain clim ing. NATURAL HISTORY sent Mr. A kinson to Arizona to "review" t Grand Canyon—the review is a ra and the Canyon got a four-star ratin

Since 1960, WILLIAM J. BREED h been Curator of Geology at t Museum of Northern Arizona Flagstaff. During his college yea a Fulbright scholarship took him the New Zealand Alps where he d research for a master's thesis. present, he is studying the Preca brian formations and the Mesoz Era of northern Arizona.

JOHN D. PALMER is Associate Pr fessor of Biology at New York U versity and has spent seven summe as researcher at the Marine Biolo cal Laboratory in Woods Ho Massachusetts. During 1963-64, attended the University of Brist England, as a National Scien Foundation Fellow studying the m gratory habits of the protozo *Euglena* (NATURAL HISTORY, Febr ary, 1967). Dr. Palmer is presen engaged in research on biologi rhythms and seasonal migratory l havior of various organisms. pecially algae, crabs, and birds.

RICHARD D. ESTES got to know t plains zebra while spending two a a half years in Tanzania's Ngor goro Crater. His interest in the l havior of animals has led him write a field guide to the behavior African mammals, soon to be pu lished by Little, Brown. He is parti larly interested in the wildebeest, which he is now finishing a docto thesis and a book. His article "Predators and Scavengers" (NA RAL HISTORY, February, 1967), gether with this latest piece, in cates the thoroughness of his obs vations of animal behavior.

The Dull Boy Who Became A Prodigy

• In 1799, an obscure Austrian clergyman, Karl Witte, told a group of skeptical friends: "If God grant me a son, I shall educate him to be a superior man – without knowing what his aptitudes may be."

• Soon, a son was born but showed little promise. The boy's own mother thought him dull. Yet by the time young Karl was six, his father's efforts seemed to be working. At age 9, he entered the University of Leipzig. At 14, he received his Ph.D.; at 23, he became a Professor and went on to a long and brilliant career.

• In Ireland, a man named Thompson heard of Witte's methods and applied them to his own sons. One became a celebrated engineer; the other became one of the world's great physicists, Lord Kelvin.

• Early in this century, Leo Wiener – rummaging in the back of a New England library – found a German book describing Witte's methods. He, too, applied them to a young son. The result: Norbert Wiener – one of the greatest mathematicians of all time, sometimes known as "the father of Automation."

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it of all, your child can achieve this success without being pushed and withterference with a happy, normal, wellted childhood.

a book like this is so badly needed

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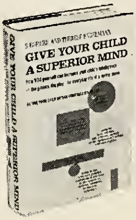

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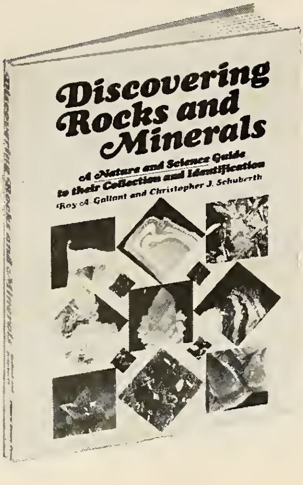
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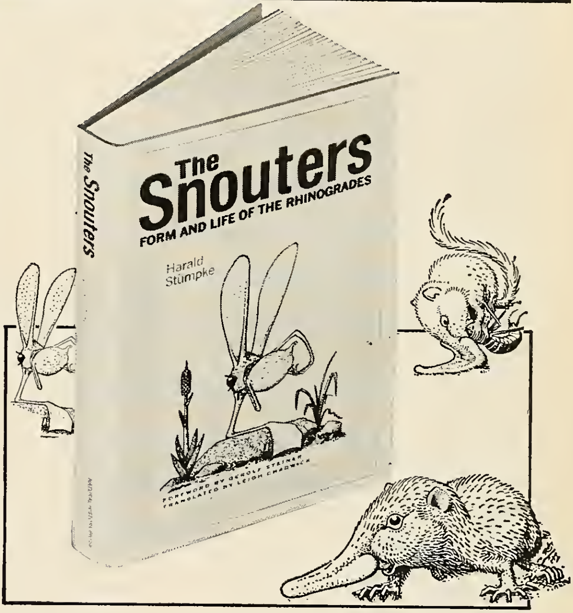
HE SNOUTERS

ORM AND LIFE OF THE RHINOGRADES

arald Stümpke

1941, a Swedish prisoner of war escaping from panese imprisonment landed on the then-unknown land of Hy-dud-dye-fee in the South Sea archielago of Hi-yi-yi. While there, he made one of the ost startling scientific discoveries of the twentieth ntury – and one of the most startling ever to hit e pages of this magazine. So startling, in fact, that e story (along with the startled reactions of *Natural istory* readers) was reported on the front page of e *New York Times.*

he discovery, of course, was that of an entirely new der of mammals, the Rhinogrades, commonly lled Snouters, whose chief characteristic – a big se – is used variously as a catapult, landing gear, d insect trap. If you read the short article about e Snouters, you will certainly want to read the *mplete* Snouters papers of Stümpke (alias Gerolf einer). If you haven't, you should start now – for, the *Hartford Courant* advised us, "You cannot exguish the Snouters . . . They have already migrated . from the land of Spoof into the safe and lasting d of Affection." Illustrated by the author. $3.95 ss 15% Associate Members' Discount).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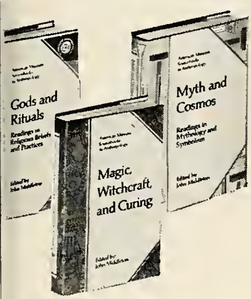

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Excerpts from "The Year 2000"

Anthony J. Wiener and Herman Kahn

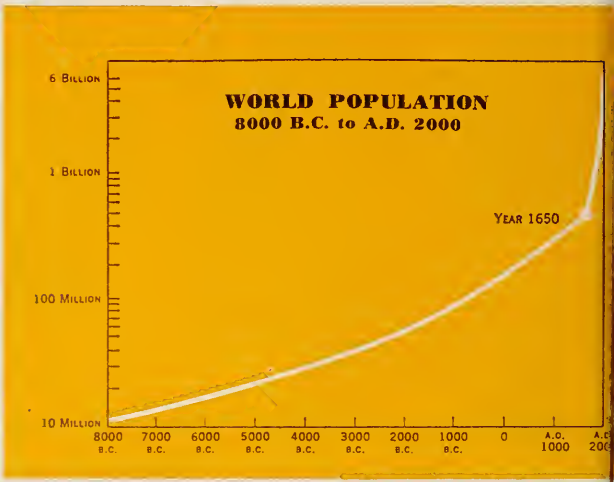
In *The Year 2000*, we described a "basic, long-term, multifold trend" that has increasingly characterized Western societies in recent centuries and seems likely to continue for some time. Processes such as economic and technological development, each facilitating the other, have become routinely—one might even say inexorably—cumulative. It is notorious that as a result the rate of change of many aspects of social life has become exponential; nor is it likely that many of the changes that are in process will begin to decelerate during the next thirty-three years.

To speak, to use tools, and to pass on learning; to put energy sources to human use; to gather food, fuel, and clothing for winter; to save, invest, plan, build, and innovate in order to decrease dangers and insecurities and to increase the power to change natural things to suit one's purposes: in sum, to render nature subject to human will—such have been the results, if not the goals, of eons of striving. Success in this sense seems to be at hand. As we approach the beginning of the twenty-first century, our capacities for, and commitment to, economic development and technological control over our environment seem to be increasing without foreseeable limit.

These accomplishments are the results of persistent and concerted effort and intelligence, and on the whole they are occasions for satisfaction. To increase economic development is to increase the availability of at least some of the things that people need and want. To develop technologically is to increase the capacity to achieve at least some human purposes that are widespread and legitimate. Clearly it is worthwhile to overcome the deprivations of economic scarcity and the dangers and frustrations of impotence before the forces of nature.

Yet the capacities of our culture and institutions to adapt to so much change in so comparatively short a time may be a major question; the stresses in domestic societies and in the international system may not be managed sufficiently by meliorist policies. Since the underdeveloped countries are even further removed in industrial and social life from these new technologies than we are, the cultural shock of their partial adaptation to the new technologies may prove even greater. The possibility must be faced that man's unremitting, Faustian striving may ultimately remake his natural conditions—environmental, social, and psychobiological—so far as to begin to dehumanize himself or to degrade his political or ecological situation i some costly or even irrevocabl manner.

While it is usually desirable t solve old problems even when th solutions themselves give rise to ne problems, it has become increasingl clear that our technological an even our economic achievements ar mixed blessings. Through progre such issues arise as the accumul tion, augmentation, and prolifer tion of weapons of mass destructio the loss of privacy and solitude; t increase of governmental and/ private power over individuals; t loss of human scale and perspecti and the dehumanization of social l or even of the psychobiological se the growth of dangerously vuln able, deceptive, or degradable c



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Man, technology, and nature in the twenty-first century—a discussion based upon an important new book

tralization of administrative or technological systems; the creation of other new capabilities so inherently dangerous as seriously to risk disastrous abuse; and the acceleration of changes that are too rapid or cataclysmic to permit successful adjustment. Perhaps most crucial, choices are posed that are too large, omplex, important, uncertain, or omprehensive to be safely left to llible humans.

Some Likely Innovations in the Last Third of the 20th Century

. Widespread use of computers for in-ellectual and professional assistance translation, teaching, literature search, edical diagnosis, traffic control, crime etection, design, analysis, and, to some egree, intellectual collaboration)

. Extensive genetic control for plants nd animals, development of new and seful species

. New techniques for preserving or nproving the environment, based upon ew understanding and concern for the cosystem

. Human "hibernation" for short pe-iods (hours or days) for medical pur-oses

. Great development of new drugs, lectronic devices, and other stimuli af-ecting emotions and thoughts; to in-ude control of memory, learning, tigue, relaxation, alertness, personal-y, perceptions, and fantasies

. Flexible penology without necessarily sing prisons (by use of new and per-aps pervasive methods of social sur-eillance, monitoring, and control)

7. Use of nuclear explosives for excavation and mining, generation of power, creation of high-temperature—high-pressure environments

8. Extensive and intensive centralization (that is, sharing) of personal and business information in high-speed data processors

9. Some control of weather and/or climate

10. Other (permanent or temporary) changes—or experiments—with the overall environment (e.g., the "permanent" increase in C-14 and temporary creation of radioactivity by nuclear explosions, the increasing generation of CO_2 in the atmosphere)

11. Cheap and widely available central war weapons and weapon systems, new methods for lethal chemical and biological warfare

12. New kinds of cheap, convenient, and reliable birth control techniques

13. General and substantial increase in life expectancy, postponement of aging, limited rejuvenation

We would not wish to arrest the rocess of technological advance-ent, perhaps not even slow it down, r it is valuable. There is a wide-read response to problems of tech-ology, in which the artifacts emselves become the targets of hos-ity; surely it would be more useful criticize human choice, in which chnology plays but a passive, in-rumental role. Nor do we find plausible the prevalent rhetoric to the effect that technology is about to open gates either to heaven or to hell, that technology now presents man with some simple and decisive choice between immolation and utopias. The latter may sometimes be hard to tell from "brave new worlds"; evils may not be stark and obvious, but subtle, slow acting, uncertain, and well distributed among all the available options.

Our purpose, then, is not to view technological and economic prospects of the next thirty-three years with alarm; to try to arouse a humanistic reaction against the forces of change. We are, on the whole, optimistic, but we wish to call attention to one of the problems that is already becoming discernible and that could—if social responses are not adequate—lead to very bad results. Specifically, we are referring to some ways in which technology might come between man and nature so as to change man's relationship not only with his ecosystem but with himself and his society.

Increasing wealth and leisure and improved technology are unlikely to have the exclusively beneficial results that are often naïvely assumed today. A principal danger in the situation is that a series of decisions can be taken separately for good reasons and yet produce an ultimate condition that—had it been foreseen—no one would have wanted.

Practically all the major technological changes since the beginnings of industrialization have resulted in unforeseen and unwanted consequences that were not taken into account at the beginning of the process. Most obvious has been the "fouling of the nest": the ecological damage done by the accumulation of the waste products—oxides, isotopes, dirt, and junk—of industrial society. Although this is part of the price we have willingly paid for economic progress, too many of the costs of previous pollution and depredation of resources now seem likely to fall on current and future generations.

Another dramatic example is provided by the advances in public health that helped to bring about the population explosion, primarily by dramatically reducing infant mortality in countries with very high birthrates. The ultimate cost of this medical progress in terms of human suffering in much of the underdeveloped world (doomed to remain underdeveloped unless it can reduce population growth) may eventually far exceed the suffering that would have occurred without such progress. Yet people are unwilling to give up

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medical progress or to refuse it to populations where too many babies are born; indeed. most would judge such action immoral.

It is likely that ways will continue to be developed to prolong human life by means of artificial organs and even, perhaps, through computerized substitutes for damaged (e.g., senile) portions of brains. This raises very starkly several ethical issues, including the possibility of dehumanizing people. While each advance in the capacity to prolong lives is welcomed for good reason, ultimately there is a danger of blurring the difference between human and nonhuman entities. If this occurs it becomes plausible that a dehumanized view of partly human beings (and, by extension, of all human beings) will be adopted. As humanoid equipment is evolved, maintained, and repaired for various special purposes, it may come to seem appropriate and reasonable to "phase out" this equipment as those purposes change. What begins as an expression of the value of the individual human life could easily become a step toward the treatment of men as objects, manipulatable or even disposable as social purposes dictate.

*

The possibility of a serious invasion of privacy by the government (or by private individuals) is raised by the rapid progress toward centralized data processing for government, business, and personal record keeping. This is clearly a serious problem, and while some discussion has involved apocalyptic language, we agree that without adequate safeguards some of these warnings may prove justified. Indeed it is possible that such problems will be raised not as a by-product of normal commercial and governmental operations, but because there has been special design and procurement of systems for the surveillance, monitoring, and control of individuals.

It is already possible to monitor conversations by the disturbances they produce on windowpanes and to photograph documents through windows and at great distances. Then, it is not difficult to imagine the large-scale "bugging" of future conversations, which could then be rapidly scanned by computers. These com-

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—This Year—

Reservations for 1967 have closed, and man tours have been completed. Enthusiastic "vete ans" will testify to a fine spring season in Nort America, the Mediterranean (where the famou Coto Doñana in Spain shared honors with th Camargue, Corsica and Greece), Great Britai Scandinavia and Iceland.

HAWAII: Our Xmas party this year is at th Volcano House, Kilauea Crater, followed by 10-day bird-and-scenery tour of the islands, wi special attention to the plant life. Places a available for this tour.

—Program for 1968

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MIDDLE AMERICA (2 weeks each): Yucata Feb. 3. Mexico West Coast, Mar. 9. Northwe Mexico, May 18. Chiapas, July 13. Yucatan, Ju 27. Guatemala-Honduras, Aug. 10. Costa Ric Panama, Aug. 24.

SOUTH AMERICA (3 wks. each): Colomb (world's top bird country, which we visit twi yearly), Feb. 17 and Aug. 10. And a series tours around the continent beginning with E uador-Galapagos, in the Fall of 1969.

EUROPE: The Europe program makes possib many combinations: South Europe, May 9; Br ain, May 30; North Germany and Sweden, M 30; Balkans, May 30; Norway, June 22; Icelan June 22; Russia, June 22.

AFRICA: South Africa, July 20; Central Afri & Madagascar, Aug. 10; East Africa, Aug. 3

ASIA: Japan, May 18. Next coverage of oth parts of Asia early in 1969: Philippines; Th land-Malaysia; India-Ceylon; Himalayas.

— SOUTH PACIFIC —

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N.Z. BOTANY: Two weeks up the west co in a land of strange plant life and magnific glaciers. December 7.

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handful of people like Mary Carnwath e trying to keep our promise to the Indians. ut they won't make it without you.

he Hopi Indians' village of ulovi in Arizona sits on land or, infertile and inhospitable o far nobody has tried to take ay from them.

lectricity has not yet reached Iopis. Water must be hauled three miles away. Jobs are few ar away. Only poverty and des- ire close-by and in abundance. et for the first time in genera- Mary Carnwath and people er are stirring hope among the .

Iary Carnwath works and two thousand miles away, in attan. Her own daughter is grown-up, and through *Save hildren Federation* she is spon- one of the village girls, 8-year- race Mahtewa.

he Mahtewas (two parents, children, one grandmother sister-in-law) live tightly d in a tiny rock and mud The father who knows ranch out can't find any most of the n't able to provide the family ven the bare necessities.

Grace, bright, ambitious and industrious, would possibly have had to quit school as soon as she was old enough to do a day's work. But, because of Mary ath, that won't be necessary. e $12.50 a month contrib- y Mary Carnwath is provid- emarkable number of things ce and her family.

ce will have a chance to con- chooling. The family has ole to make its home a little vable. And with the money er, together with funds from onsors, the village has been renovate a dilapidated build- use as a village center. The now has two manual sewing es that are the beginnings of income-producing business. y a small beginning. More and more people like Mary th are needed. With your erhaps this village program will produce enough money to end the Hopi's need for help. That is what Save the Children is all about.

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puters would be capable of detecting certain special interest criteria (use of words such as *bet*, *kill*, *black power*, *oppose*, *revolution;* signs such as angry gestures, threatening voice tones, etc.) indicating whether or not the conversations should be recorded for further analysis. TV monitors both indoors and out may become common as the techniques become cheaper. It may turn out that only those with enormous resources will be able—and then only partly and perhaps only by bribery or political manipulation—to avoid some monitoring or to interfere with transmission of the data. At the minimum, if the monitoring exists, new code languages will develop in efforts to evade some of the consequences.

One standard cliché of the literature of social planning emphasizes that complex societies are more vulnerable to disruption than simple societies. The complex society has greater instantaneous and long-range flexibility, but less useful redundancy and more bottlenecks that could affect it. Thus it may be more affected by major interruptions that overwhelm its instantaneous or short-run adjustment capability before the long-range flexibility has a chance to work. Unlike the simple society, the modern industrial society is highly differentiated and therefore requires great integration in order to function. A disrupted complex society at least under some important conditions, may not be able even to sustain the low level of productivity that is normal to a simple society.

Greater wealth and improved technology give us a wider range of alternatives; but once an alternative has been chosen, much regulation and imposed order is needed. Thus, geometric increase in the complexity and organization of modern life will necessitate corresponding, even if not directly proportional, increases in the scope and complexity of human and organizational controls. One need not assume the triumph of the police mentality, or the intrusion of motivation that denigrates human dignity, to foresee this. Each restriction will have its valid and attractive rationale, which may even be libertarian. Federal safety regulations for automobile manufacturers and tests for drivers today increase the "freedom" of the license-holding driver to drive in safety. Coercive treatment for the mentally ill raises the probability that they will be able to lead freely constructive lives. Therapeutic abortions, through the death of the fetus, increase the freedom of the mother. And the biological adaptation of man to his ecological niche in an extremely complicated and overpopulated society will increase his freedom to live a satisfying and useful life.

We have, of course, omitted the crucial qualification, under the existent conditions. It is still possible that the terminus of the process may be inconsistent with anything we would regard as freedom or dignity or even human. The evolution of society may produce the devolution of man. The adaptability (and superiority) of man has heretofore consisted in his lack of specialized adaptation (as in the case of the lesser animals) Man may, in the not too distant future, be adapted in a specialized sense, while society through the control of genetic science maintains its general adaptability by fitting men to the varying tasks that time and environment provide. (Thus, as Morton A. Kaplan put it, "the survival of the fittest may be replaced by the fitting of the survivors.")

It would be clearly erroneous to compare man to the lemming, but every known animal species on which experimental overcrowding has been carried out is dysfunctionally disorganized. Rules governing mutual adjustment will inevitably be very stringent, and there will be a strong emphasis on adjustment (other-directed orientations) in place of individualism. Resort to drugs, otherworldly religions, delinquency, crime, and mental disease (as ways of "opting out") could increase significantly, requiring medical, social and criminal sanctions to prevent or contain those forms of disturbance that are excessively dysfunctional.

The consequences of dislocation and mistakes in the production, logistics (distribution), and control functions of business and government are likely to be so huge that the facilities for coping with them must take precedence over civil liberties or private pursuits and property. The blackout of the east coast in 1965 only suggests what can go wrong in the future. (That particular disturbance need not have occurred with proper control systems, but that is the prob

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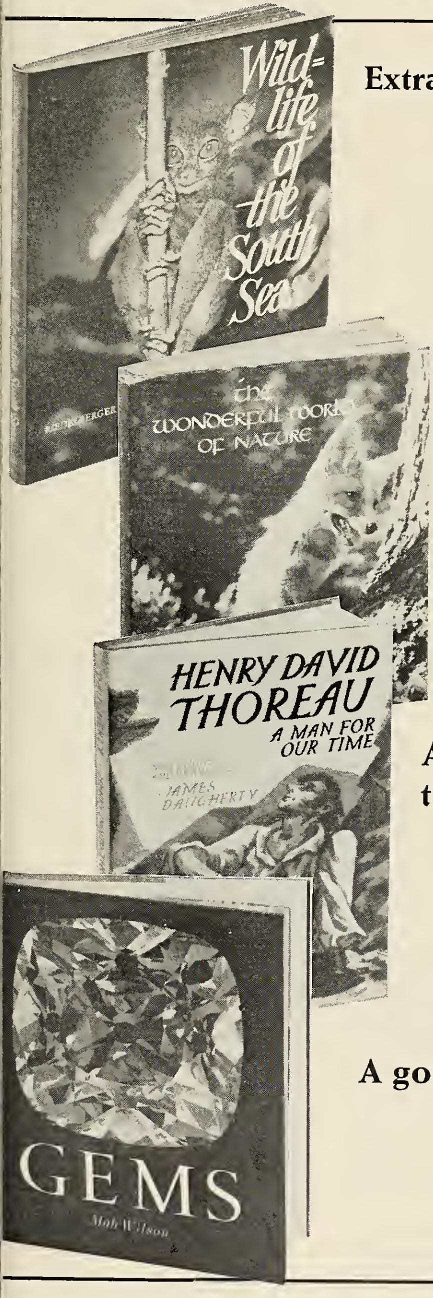

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by Mab Wilson

THE VIKING PRESS 625 Madison Avenue, New York, N.Y. 10022 lem. On the one hand, there could be extremely sophisticated and prudent system designs or, on the other, there could be extensive supervision to avoid the possibility of relatively far-fetched disasters.) Needs for control and surveillance will develop to utilize (or as Parkinson might say, "expand to fill") the technological capabilities that are present in the system. Technological developments will, in addition to meeting environmental requirements, produce needs to satisfy technological capabilities.

*

As always, the central government would so likely be swamped by the problem of keeping the system functioning properly that it would be concerned only with marginal and immediate problems rather than with long-run, basic issues. In any event there may be no rational or moral feasible solution that does not reject the whole of modern technology or condemn billions of surplus humans to death or deprivation. The twenty-first century would no more be able to return to the world of the twentieth century than we can return to the golden age of Greece.

*

The Faust legend is a metaphor for a central predicament of modern man. We are interested in it primarily as it gives rise to insights concerning the consequences of the multifold trend characteristic of our culture. For the moment let us set aside the differences in treatments of this legend by several authors, or the same author at different times, as well as divergent critical interpretations. The most popular literary treatments —those by Marlowe and Goethe—do provide at least poetic insight into the problems we have been raising. Marlowe's version is more faithful to the early folk tale, but Goethe's version possesses that poetic ambiguity and complexity that raises the legend to the level of archetype or myth. In both versions, Faust sells his soul to the devil in order to acquire knowledge, power, riches, and women—typical sensate goals.

The object of pragmatic, empiric (sensate) knowledge is to contr rather than to comprehend nature to understand it instrumentally an manipulatively, rather than emphat cally, normatively, or mythicall Such knowledge is a tool, not for th philosopher, but for *homo faber,* ma the maker or doer, who gambles wi fate (Fortuna, or chance, is a wo an) to seize those rare opportuniti that might never recur. Faustia man, or *homo faber,* is secular, pr fane, and sensate, rather than the logical, philosophical, or theoretica

The medieval play emphasizes th distinction between the sacred an the secular, between the body an the soul. During performances of th play, or puppet show, Faust woul often be prompted from the stage (c even from the audience), "Repen repent, it is not yet too late." A though he replies to the audience, ' have made a bargain and I will stic with it," he nonetheless vainly a tempts to repent in the death scen The lesson is clear: one may pay to high a price for worldly power, an after the penalty is apparent, repen ance is too late. The myths of Pr metheus and Icarus—and even th apple of the tree of knowledge—e pressed similar misgivings about th potential consequence of striving fo prowess with which to transcend hi man limitations and to subjugate th forces of nature. When Faust buil a new area in which people can find new life, in which swamps ar drained and dikes built to hold bac the sea, he rejoices that dikes ca never be perfect, since "Freedom an life are earned by those alone wh conquer them each day anew."

Faust is not immoral but amora He is indifferent to the fate of thos who stand in his way rather tha brutal; the brutal actions in the pla are performed by Faust's agen without Faust's knowledge. Howeve lest the reader think that Faust woul have countermanded this brutalit there is one episode in which an o couple is ruthlessly evicted from the property by Faust himself eve though their property is not essenti to his scheme. They are in his wa and like a force of nature, he brush them aside.

We are far from suggesting th the processes once presented by th basic multifold trend can be ove come. Janus, looking both backwa

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and forward, must be the most disillusioned of all. Few of us are likely to return to the naïve optimism of the Enlightenment, to the rationalistic confidence in historical progress that is still dying slowly in both East and West, slowest of all in the U.S., while it continues to gain new adherents in the developing nations and in new nationalistic Communist groups. Some of the social trends, technological innovations, and levels of economic development that forecast a nightmarish twenty-first century are almost surely not reversible by any means short of holocaust.

Yet, if the cycle cannot be stopped, if the warring elements cannot be eliminated (as indeed they could not without the elimination of man), we can perhaps hope that they can be moderated. Just as the economist hopes to avoid not all the phenomena of business cycles, but only their extreme troughs and depressions, so perhaps we can hope with adequate knowledge and intelligence to control the extreme dips and rises of the cultural cycles. If man may never be completely in control of his fate, perhaps at least he may rise to partial control.

We share the prevailing humanistic view that man's increasing capability to alter his environment (not only the outside world but his own physiological and intrapsychic situation as well) amounts to "progress." It would be no more desirable than feasible to attempt to permanently halt the processes of technological and economic development, or to reverse them. Yet our very power over nature threatens to become itself a force of nature that is out of control, as the social framework of action obscures and thwarts not only the human objectives of all the striving for "achievement" and "advancement" but also the inarticulate or ideological reactions against the process. In the last decades of this century, we shall have the power to change the world even more radically than has already been done, but probably we will not develop much ability to restrain our strivings, let alone understand or control the results of these changes. But if we cannot learn to cope with the dangerous responsibilities of our technological success, w may only have thrown off one se of chains—nature-imposed—for an other, ostensibly man-made, but in a deeper sense, as Faust learned, als imposed by nature.

If there is any single lesson tha emerges from the above, it seems t be this: while it would certainly b desirable and might even be helpfu to have a better grasp of how socia action may lead to unanticipated o unwanted results, this is not likel to be sufficient. Given man's vastly ir creased power over his environmen and the unprecedented opportunitie for centralization of social contr that follows, the effects of soci policies—planned or haphazard—ar likely to increase drastically, and th consequences of mistakes are likel to grow correspondingly disastrou While all decisions are in a sense i revocable, this existential fact mu be appreciated increasingly as it b comes an ever more dominant aspe of policy decisions.

Of course, it will be worthwhile t try to improve our understanding policies and their consequences, b the problem is ultimately too difficul and these efforts can never be e tirely successful. Almost the on safeguard that then remains is to t in general to moderate Faustian in pulses to overpower the environmen and to try to decrease both the ce tralization and the willingness to u accumulating power, or to arran matters—somehow—so that th power is placed in the hands of pe ple who will respect its disastro potential and will not centralize further. What is necessary is an u flagging respect for the world as find it and for dissent and diversit even for ornery individual stubbor ness, in spite of the mounting i pressiveness of the technical-ration structure that bourgeois, sensate s ciety is building. Above all, the must be a concern for perpetuati those institutions that protect fre dom of human choice, not only f today's individuals and the plur istic social groups that would wa their views represented, but more i portant, for those who will follow —those who in the future may e perience their problems different and would not want to find that have already foreclosed their choic and altered their natural and soc world irretrievably.

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A Naturalist's Wife at Bay

A Horde Uncountable

by Nancy Bell Bates

In his second column of "A Naturalist at Large," the Boss remarked that with the setting up of the "garden" and the arrival of hummingbirds and honeycreepers, of Héloïse, the iguana, and of assorted monkeys "the household has never been the same." At that time, we of the household readily and delightedly agreed with him. We were thinking of the pleasure of seeing a red hibiscus flower blooming against the background of midwinter snow or the joy of feeling a hummingbird's tiny feet on our fingers at feeding time. We did not realize that, as a chapter in Marston's book *Coral Island* proclaims, there are "Flaws in Paradise."

Anyone playing God in a small way, even in only 500 square feet of space, is bound to have failures in setting up a balance between flora and fauna. And with these failures—such as the necessary departure of the overheavy saimiri monkeys and the overfecund cotton rats, the death, for a variety of reasons, of birds, lizards, and turtles, the utter disappearance of several finches and a large number of bright little frogs from Colombia, and the truly tragic loss to all of us of Bronzy, tamest and most charming of the hummingbirds—we have learned by trial and error. Bronzy got caught in a small jar and was not found in time—hummingbirds can live only about five hours without feeding. We still remember him with great affection. If only he could have called to us!

On the other hand, Héloïse has been rescued from what seemed the final stages of starvation by force feeding, the marmosets were rejuvenated by extra vitamin D, as suggested in Gerald Durrell's book *Menagerie Manor*, and Ethel, the honeycreeper, has hatched two eggs—although both nestlings died within ten days—and is now brooding her fifth or sixth clutch in the tea strainer by the door. Successes and failures: we of the household have followed them all with interest and sympathy. With one exception. I refer to the invasion, as the garden has grown, of a host, a horde uncountable, of cockroaches.

Hidden in the soil of plants from Florida or the packing that brought reptiles safely from Colombia, the egg cases of several species must have landed in comfortable places about the garden, there to hatch and start this process. Fine and dandy, if, like the birds, monkeys, and Héloïse, they would have remained in the garden to add to the natural fauna of this "experimental rain forest," but they didn't and they don't. We have long been accustomed to houseflies and fruit flies, but cockroaches are something else again.

In an article in *Harper's* for December of last year, Dr. Howard Evans extolls the wonders of "The Intellectual and Emotional World o the Cockroach" and claims that structurally unchanged since befor the advent of man, they are not onl tremendously adaptable but als trainable. He heartily commends th cockroach, although he says, "H must, of course, be met on his ow terms, in his own world." With hi world and mine overlapping mor and more, this phrase has come t

---

Mrs. Bates is the author of "East of th Andes and West of Nowhere."

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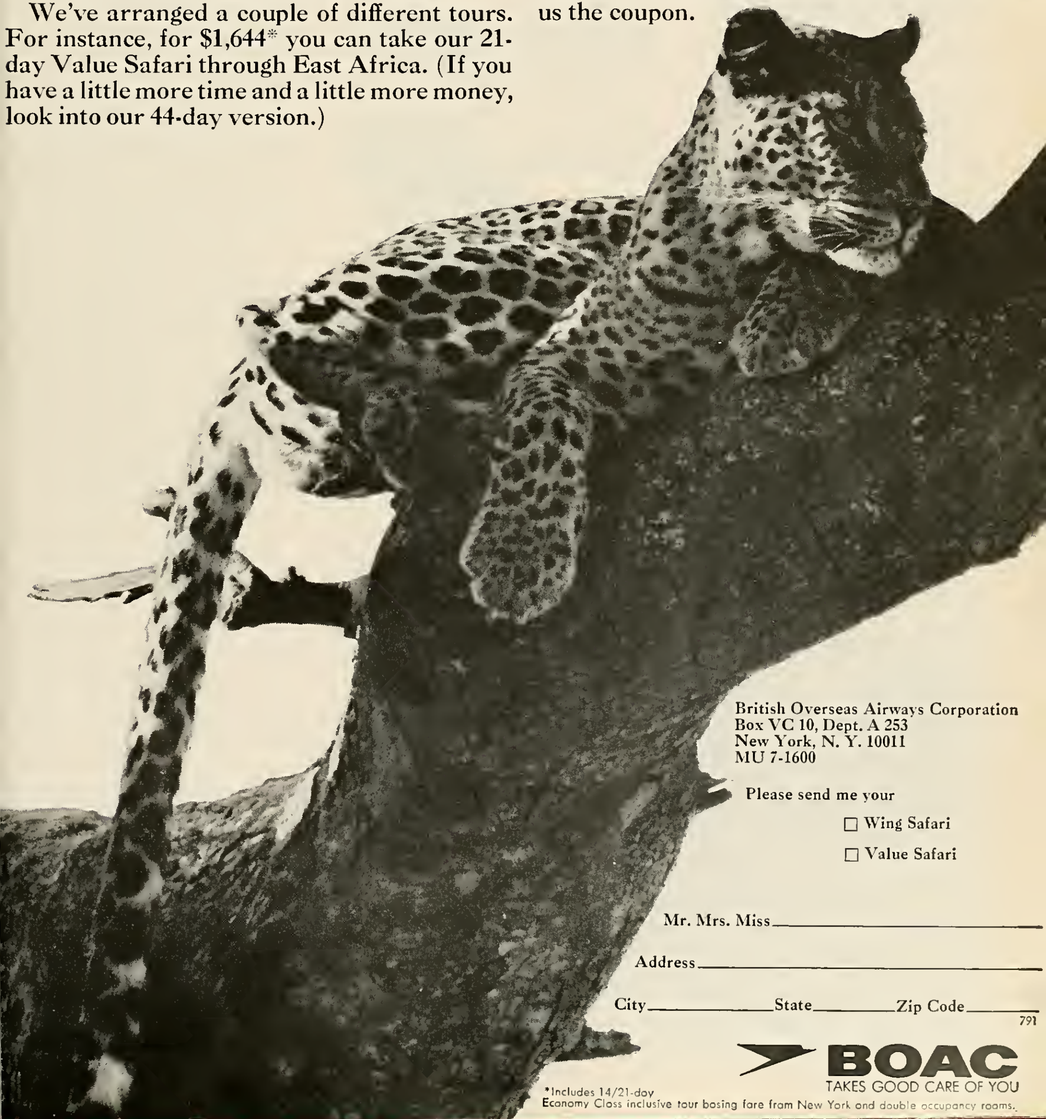

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have a sinister meaning for me
time goes on. Dr. Evans is most we
come to try to come to terms wit
our cockroaches; we have space
spare and would put him up inde
nitely. Could they be trained to la
their eggs in moist sand as he sa
one species do in a Florida state par
or don't we have the egg-buryin
kind? Most probably not, for the
are 3,500 species now in existence (
which "fewer than five percent hav
been studied in any detail," to quo
Dr. Evans again) and our luck ha
surely brought us the kind that neve
thought of such a thing.

The article, incidentally, is fasc
nating, if somewhat discouraging, t
the housewife put at bay by th
roach's agility, fertility, and ingen
ity. In this house they do not simpl
drop their egg cases on the floo
where at least we might destroy som
of them; they hide them under alar
clocks, behind books, in the dark r
cesses at the backs of kitchen dra
ers, in the basement, and even in th
living room, judging by the popul
tion explosion there.

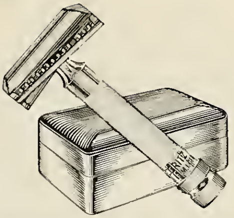
Surely it is unnecessary to descri
the feelings of a middle-class, middl
aged, midwestern housewife whe
confronted with cockroaches n
only in her cupboards but in the te
kettle; not only in the bread box b
in the refrigerator! True, my hous
keeping is casual and intermitten
guaranteed to make the efficient fe
smug and the inefficient feel at eas
perhaps even superior. But in spi
of this, during all the previous yea
in our house we had encountere
only one cockroach. Now the pla
reminds me of the town of Hamel
before the arrival of the Pied Piper

Symbol as they are of dirt, diseas
and sloppy housekeeping—though
might add here that experts find the
less unclean than many other typ
of vermin—roaches are the only cre
tures of which I have a real horr
to which my reactions are instant
neous and violent. Rats, mice, snak
lizards, spiders, chiggers, mosq
toes, wasps, even lice—which we
found on my head at about the a
of ten and combatted, somewh
drastically I thought, with kerose
—almost all creeping things are to
"nature's creatures." But not coc
roaches. But then it seems to me th
almost everyone has a horror
something special: some people do
mind roaches but can't stand spide
some go in deadly fear of wasps

ees. Lizards must be high on the list, o high that it is forbidden by law sell them in pet shops in Detroit. used to wonder if anyone had tried catalogue or categorize the various iings that people are afraid of. Well. ccording to the book entitled *Men nd Snakes*, by Ramona and Des- iond Morris, a survey of this sort as done in England in April. 1961, nd repeated in October, 1962, using V and a national newspaper to ask ie questions, “Which animal do you ke most? Which animal do you dis- ke most? Which animal topic would ou most like to see dealt with in iture animal programmes on tele- ision?” I find it interesting that ckroaches are not on the list of the p ten dislikes at all, but that while iakes topped the list by a vast ma- rity, spiders came second. I now about asking my friends the first vo questions. but in my anecdotal ay can only report that reptiles do em to hold first rank. with snakes ore feared than lizards. Even Mar- on has often remarked that he is ire if he were bitten by a snake he ould die of fright!

This last fact is a comfort to me fighting what must be an “imprint” the Lorenzian sense. for how else explain this terror, this completely itomatic revulsion that seizes me hen a large roach lands upon me? fter all, I was brought up mostly Florida where all these beasties ound. I also had a big brother who it June bugs down my neck or ittery moths in my hair, as big others often do. My reaction to this as to set out to learn not to fear em. to hold them in my hand, to el the flutter of a moth's wings or e rasp of a June bug's legs. Why en can't I hold a gentle, harmless ckroach? This challenge has gone imet during many years in Florida d in Colombia, S.A. Will it now me to pass that I shall overcome y weakness in Ann Arbor, Michi- n? For surely it is a weakness un- rthy of a naturalist's wife!

Just the other day Marston handed a book by John Rublowsky, en- led *Nature in the City*, with the re- irk that the chapter on “Crawling iings” might be of interest to me. was, if perhaps not in the way he tended. It only increased my feel- g of being engaged in an endless, ing battle against these representa- es of “one of the oldest life forms the world.” Our huge old house is



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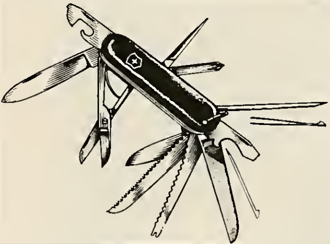

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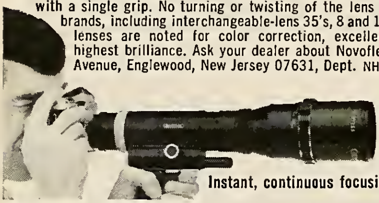

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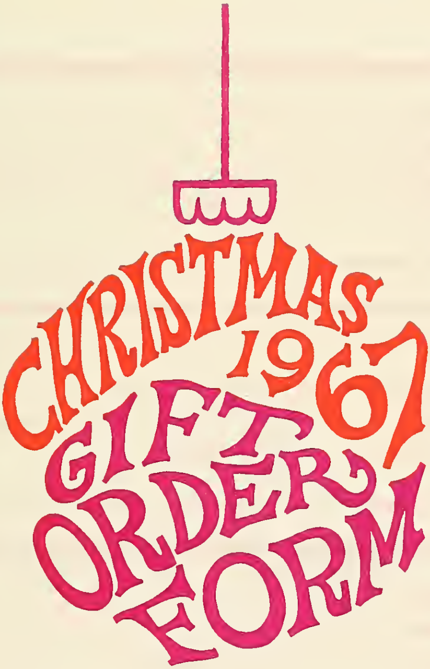
an ideal habitat for these creatures that thrive in warm dark places. We can almost hear them munching not only on our food and that of the pets but also on our books, on the papers in our files, on soap and wool and even shoe polish. Leave an open package of cigarettes too long in the same place and the cigarettes are riddled with tiny holes where the paper has been chewed. Leave the dregs of your wine on the living-room table at night and in the morning it will be crowded with the dead and the dying. Anything missing or mislaid is blamed on them these days. Who took Ethel's first nestling from her nest at the age of three days? Who cleans up the turtles' tray each night, when, having only three, we put out enough food for six? Who, indeed, made off last week with $25 from my wallet and half a bottle of bourbon?

So far, we seem to have two species in the house, although no doubt there are several others in the garden (remember, 3,500 species in all!) willing and able to find their way where others have blazed the path. The less objectionable, though more in evidence, being not nearly as coy and nocturnal as the others, is the small narrow, light-grayish kind—*Blattell germanica* is the scientific name—otherwise known as Croton bug Much worse is *Periplaneta americana;* it zooms about like a miniatur bat, particularly when pursued b one of us armed with a spray bomb And when these land on me, I whinn like a wounded horse. When you ste on them they crunch. And as hostess, what does one say when guest, or perhaps one of the semina students sitting on the living-room rug, recoils and points and says "What is that?" My embarrassed an apologetic explanations are variousl received, to the obvious glee of th head of the house, who sits by, als on the floor, of course, and grins. A ter all, he likes cockroaches. It wa interesting, perhaps downright con forting, to have him admit not lon ago that even he was somewhat take aback, on going into the garden a night after the lights had been off fo a while, to find a wall-to-wall carpe ing of roaches!

Of far greater comfort, howeve is the fact that the other members the household feel as I do. Marsto devising an ingenious method trapping roaches alive, was at first a for returning them to the garden. B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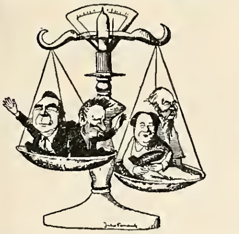

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the rest of us would have none of that; they are either flushed down the drain or squashed and thrown out.

Since Marston's traps proved so effective, I shall describe them. Simply take a laboratory finger-bowl—or any smooth-sided, wide-mouthed container—and grease the inside walls. Oil, butter, bacon fat, almost anything slippery will do (except vegetable shortening—it seems too solid), and with a bit of pet food, hamburger, or almost anything as bait you can attract the monsters in to where they cannot climb out nor yet have room to take off in flight. We have caught as many as thirty in one bowl hidden overnight. At first we took great care to hide these traps lest the three cats and two dogs who share the house with us get there before the roaches. But when we began to find roaches drowned in glasses of wine or beer left overnight in the living room it occurred to us that here might be the ideal bait, for the pets, unlike most of the people around here, are non-alcoholic. And then in a bulletin on *The Principal Household Insects of the United States*, written in 1896 by L. O. Howard and C. L. Marlatt, we found a specific recommendation of stale beer as bait. Both authors were close friends of my father; indeed Dr. Marlatt was "Uncle Charles" to me. In the section on remedies Dr. Marlatt gives a number of trap designs, all on the same principle of enticing roaches in to where they cannot get out. Being liberally supplied with lab bowls, roly-poly highball glasses, and widemouthed jars, we have been running experiments in the garden using various materials as bait, and can now report that beer has it all over red wine, white wine, and bourbon and water, even though, as Marston remarked, "It was the very best wine." Pet food still runs beer a close second, but the advantage of beer is that the creatures drown, while with the non-liquids they have to be killed, which is always an unpleasant and somewhat guilt-producing process. Unless, of course, one has aggressions to get rid of.

At this point, our readers are probably wondering why on earth we don't tear the place apart and spray every nook and cranny, every possible hiding place. Well, that's quite a large order in a seven-bedroom house with three floors—no, four if you include the attic, a repository for the

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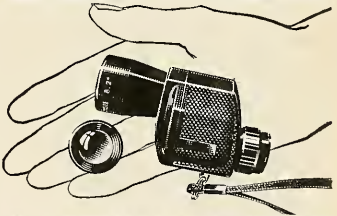

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belongings of numberless people over numberless years—and in nearly every room, bookshelves crammed to overflowing. Or why not call in an exterminator? Ah, but remember, we have a jungle in the house, or right next to it: a small bit of rain forest, a tiny "ecosystem," a living work of art. It is quite possible that just one cockroach escaping the exterminator might carry the garden's doom on his prickly feet. I remember well, after reading Rachel Carson's *Silent Spring,* how we welcomed the presence of fruit flies in our cups of wine, even were pleased to see houseflies and ants as proof that there was no DDT about. We remember the robin someone picked up from his lawn and brought to us that died in convulsions as we held it. Robins still seem scarce around here the first days of spring; they do not wake us at dawn as they used to. Such dreadful poison would not take long to go from roaches to fruit flies and through them to the hummingbirds. So now when we do spray, it is with great circumspection, using compounds that contain no DDT and not in the rooms adjoining the garden. I must admit, however, that this is a fragile principle, and that in the heat of the chase, some of us have—and not seldom—pursued an enemy over the forbidden line into the dining room and the living room. It is so easy to forget at such a time.

Some months ago, Archie Cowan, Associate Professor of Wildlife Management (wild life indeed?), came by to view the garden and over a few drinks informed us that he had a very fine, white silicate powder that had such a desiccating effect that when merely walked over by roaches it dried them up in a matter of minutes. It was also harmless to most other animals. His offer of a sample was quickly accepted, and when it arrived, we immediately put it to the test. The reaction, while not instantaneous, was quite spectacular. Within a few hours roaches came staggering out from everywhere, a great many, oddly enough, from behind the door-gong on the kitchen wall. And for a while there seemed to be a lessening of the invasion, with dried corpses turning up in the most peculiar places. But the process of sprinkling powder around at stated intervals is
a tedious one, demanding more c
ganizational ability and consisten
than I am capable of. Besides, y
don't get the spectacular results, t
visual impact of a whole bowlful
the enemy drowned in stale be
Blessings on you, Uncle Charles, n
dead these many years, for that bul
tin written in 1896!

And so, with spray bombs, t
white powder, and above all wi
beer, the battle goes on, for we kn
that in the garden the legions a
growing to the point where ev
Marston's co-operation is no long
in doubt. He is afraid the roach
may eat up all the rotting fruit th
breeds the fruit flies that feed t
hummingbirds, the frogs, and lizar
There was a time, not so far ba
when he mentioned several times th
someone in the Entomology Depa
ment at the University's Museum
Zoology had offered him roach
from Madagascar as big as m
turtles, and as he said this, a sort
speculative, almost wistful glea
would come into his eyes.

It is, however, a constantly chan
ing situation, for not only are
finding the *Periplaneta* to be defini

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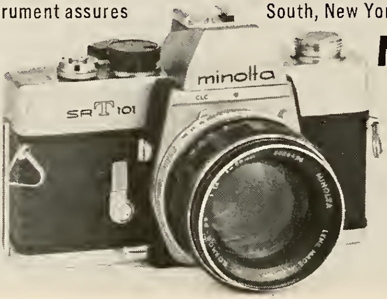

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ly driving out the Croton bugs, but we of the household are showing definite signs of adaptation as well. Now, of an evening when a few come crawling out of the stove at the onset of cooking, provided they are small enough, I can coolly squash them with a finger, saying "Die!" in triumphant tones, and count them as they are dropped into the garbage pail. It has also become easier to step on the large and crunchy kind, possible to look closely at a huge one in a trap, even to touch an antenna, or to pick up the occasional desiccated corpse. But let one land upon me and the old revulsion sets up the immediate and violent reaction. Only recently, encountering a large *Periplaneta* half drowned in the sink, I determined it was now or never, and with a pair of tweezers picked him up. With a surge of courage I held him tightly between thumb and forefinger. And I looked him in the eye, let his one feeler wave about in a feeble dying way. Interesting he certainly was, the head so tiny and hidden compared to the rest of him, his brown covering with its curious markings even handsome in a way. But not lovable, not interesting enough to me just yet to escape death. However, as they say in Spanish, *Poco a poco se anda lejos* ("little by little one goes a long way"); and who knows, I may yet come to accept these flaws in Paradise casually.

Lest this tirade tend to discourage anyone from building a bit of tropical rain forest in the "intemperate" zone, let me insist that the price we have paid for it is far outweighed by the joy that the jungle in the house has given us. We've grown accustomed to the warmth, the sounds, the smells of the tropics coming to us when winter is outside. Most of the birds, the monkeys, and the iguana have personal names—Héloïse and Brunhilde have already made their public appearance in these pages—and Ethel's never-ending maternal urge has us all fascinated. Is this latest clutch fertile, as the past three have not been? If she hatches, will they live as the first two nestlings did not? We are just as anxious as Marston is to add the call of tree frogs to the chorus in the garden. And even the "invasion" has provided the excitement of a campaign, a few pseudoscientific experiments, and a great deal of laughter.

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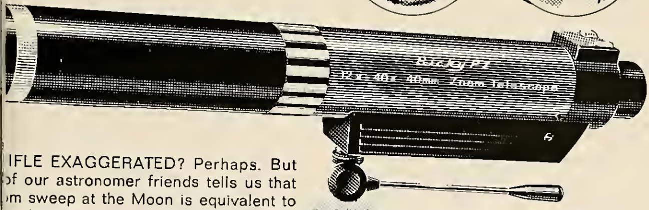

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The reviewers for Natural History's annual survey are members of the staff of The American Museum with the exception of Richard M. Klein of The University of Vermont and Deana T. Klein of St. Michael's College. The books reviewed are those that deal with the biological and earth sciences, astronomy, and anthropology and are intended for junior and senior high school students.

Reprints of this year's survey will be made available without cost to teachers and librarians who write us on their official letterhead and include a stamped, self-addressed envelope. Others wishing reprints may obtain them at the cost price of 20 cents each.

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Anthropology

There are certain qualities that any book for young people should have. If the book is intended to instruct, it is not absolved from literary considerations; on the contrary, the standards should be even higher. Such books should create an interest in the subject and hold that interest throughout. They must be authentic. This goes beyond mere accuracy of fact: it involves accuracy of judgment, honesty of presentation, and imagination based upon a secure academic foundation. Science books should also be presented in a scientific manner, and not be a mere miscellany of data, however accurate that data may be. Without order there can be no understanding, only bewilderment or, even worse, boredom. Given the requisite qualities, a science book written for young people should be an exciting and worthwhile experience for any reader.

Any book dealing with a scientific subject is fair game for this review, even if it does not set out to be an academic book. Some, written plainly with interest rather than instruction in mind, however, may turn out to be far more acceptable than those written specifically as an educational tool. There are examples of each among this year's books that deal with one or another aspect of anthropology.

The Innocent Assassins, by Fred A. Salazar with Jack Herschlag (Dutton, $5.95), is primarily an adventure book dealing with a recent amateur exploration of Brazil. As an adventure book it is barely passable, and I would have no great quarrel with it, but the author claims to have discovered and understood the people and cultures that crossed his path. Yet he plainly can see only in terms of, and in relation to, his own values, so that although he tells us "we had observed their work and play, shared their joy and sorrow, we have watched them go off to war, walked with them through the jungle, fished and hunted with them," he continues this passage with the incidental throwaway that he even "learned something of their language"! Two pages later, and doubtless with a vocabulary enriched by as many new words, "Little by little we pieced together the story of Waica courtship and marriage." Now if the author had merely described what he saw and offered his own opinions there would be no quarrel. He might even have inadvertently provided some information from which a sensible young reader could have drawn sensible conclusions. But to pretend, while on such an adventure and without proper training, to be able to arrive at conclusions concerning the nature of human society is ludicrous. And to try to authenticate the conclusions given by claiming to have "lived and hunted" with the people concerned, as though this were all that was needed to make an anthropologist, would be hilarious if it was not so dangerous.

On the other hand, *Raven's Cry*, by Christie Harris (Atheneum, $3.95), does not pretend to be any more than a novel, telling of life among the Haida at the end of the eighteenth century. As such it catches the interest and holds it, while at the same time introducing, almost by sleight of hand, many very real and pertinent anthropological observations. Social institutions such as the potlatch, totems, family structure, and trade are brought into the picture like the sweetest sugar-coated pills, and anyone reading this book is, whether he likes it or not, going to emerge not only interested but informed. Yet the book is utterly without pretense. If I say I wish it had been better illustrated, I say it in the constructive hope that next time it, or its successor, will be. But even without any illustrations it would stand on its own as a science book.

Some of the books that assume a scientific format would barely pass even as novels, and the facts are colored by opinions made with totally inadequate scientific backing. *The First Farmers*, by Leonard Weisgard (Coward-McCann, $3.64), has a good format and imaginative illustrations, and promises well, yet seems written with insufficient understanding. There is much gross oversimplification and statements of opinion that suit the author's argument well enough, but which simply cannot be proven and, most likely, are not in the least true. The old notion that early hunters were "at the mercy of nature" is once again propounded, to show how bright and independent the farmers were, as though either a new biological species had suddenly evolved or as though hunters suddenly stopped being hunters and became farmers. The author sets forth with remarkable determination a hypothetical division of labor, which again is a gross oversimplification, and such oversimplifications become plainly boring. Any young reade would be far more interested to know the truth, which is that we really have no proof whatsoever about how hunters became farmers and how they lived. We have lots of evidence, much of i conflicting. Why not give the young reader this evidence and a push in th right direction (as seen by the author) and let him make up his own mind Even the illustrations cannot be relie upon. To represent a digging stick an to be "scientific," the author (or artist) has inserted a wedge that, on som digging sticks, must have prevented th weight from sliding when the stick wa being used. Unfortunately, the wedg is upside down and would merely hel the weight on its downward way.

A number of books are neither goo nor bad, but just warm up the same ol food, which, I fear, is going to begi tasting somewhat stale. *Exploring th World of Archaeology*, by P. E. Cleato (Children's Press, $3.95), is the bes of these—well illustrated, with good a lusions to, and comparisons with, th contemporary world. It deals with di ferent cultures from both Old Worl and New, and with historic inventio such as writing. It is intelligent an lucid, yet somehow it is not new, an assumes that young readers could n

cience Books for Young People

ke anything deeper than a general urvey. However, as a survey it is good.

The Morning of Mankind (New York raphic Society, $4.95) and *To the ock of Darius* (Holt, Rinehart & inston, $3.95) are by the same auor, Robert Silverberg. The first is nusual only for the welter of undocuented and unexplained illustrations. am all in favor of letting the reader nd out something for himself, but venty-seven illustrations on one and half pages is asking too much, and xplanatory captions saying "tools," arvings," or "symbols" do not help a eat deal. On the other hand, *To the ock of Darius* is a chatty eyewitness ography of an archeologist, and alough the device is pretty transparent at times painfully so—it is a book that ight well get a young reader interted in a subject that could otherwise unbearably dull, namely the dephering of cuneiform writing.

The Adventure of Man, by Arthur S. regor (Macmillan, $4.50), starts with ehistoric monsters and ends up with morrow, and all of this in so short space seems to be cheating the younger of something, somewhere along the ne. The generalizations are necesrily so broad as to be meaningless.

There are a couple of the usual picre books. Shirley Glubok's *The Art Ancient Peru* (Harper & Row, .50) is a series of reasonable photoaphs of the kind of pieces we see ustrated in dozens of other art books, venture stories, or travel posters. But those other contexts they have more int. Here they are in black and white, th a text that adds almost nothing our understanding of what they e or what their significance is. The st one can say for this kind of book that it is easy to look at and the lor of the paper is mildly imaginae; it is all right for anyone who likes look at pictures, but it should not submitted as a science book.

From Bush to City, by Marc and elyne Bernheim (Harcourt, Brace & orld, $4.50), however, ranks much her because the photographs, alough less "arty," all tell something t, if not self-evident, is clarified the ample text. It deals with connporary Africa and can certainly d to an interest and understanding something of that vast continent.

ne book, written by a professor of arts, is particularly disappointing because with the authority at his disposal, and a sound idea, the presentation lets him down. In *Mounds, Towns and Totems*, by Robert Myron (World, $3.95), there are quite inadequate illustrations of the fascinating mounds described, and the information is amassed in each chapter as though all authentic data had been swept up off the floor, briefly reclassified, and set out in print without further thought. In order, in one chapter, such data concern death, housebuilding, farming, hunting, spear throwers, tobacco smoking, metalworking, pottery, pipe types, engraved stone tablets, and physical types. The author plainly has a mass of information at his disposal, and all of it is usable; he also has the zest and interest in his subject that would make a first-class book, but this is not it.

There are only two really good books. Elizabeth Bartlett Thompson's *Africa: Past and Present* (Houghton Mifflin, $5.00) is historical more than anthropological, yet I include it gladly because it helps us to comprehend human society and human behavior. The author, furthermore, plainly has an understanding of anthropology, and the book loses no opportunity to use this understanding to explain the why and wherefore of historical events. The book is immediately interesting; it does not try to deal with the whole sweep of history but picks on the essential moments, tempting the reader to go off on his own and find out more. It is written with a sureness and confidence that is a fine contrast to the weakness that always betrays itself by dogmatism. This book poses as many questions as it answers, and is not afraid of admitting the present limitations of our knowledge. Excellent photographs are throughout; they help make the points in the text and are not mere decoration. The whole book is a pleasure.

The other, and only other, really good book is *Land of the Mayas: Yesterday and Today*, by Carleton Beals (Abelard-Schuman, $4.95). For once the subtitle is important. This is a fine, sensitive book with good illustrations that, together with the text, bring the subject to life. In good, descriptive narrative style the author, like the author of the volume *Africa: Past and Present*, immediately plunges the reader into the subject, catching and holding his interest. *Yesterday* and *Today* are skillfully blended; the ruins come strangely to life peopled with present-day Mayas, and the people of today, living a simple rural life, gain a touching dignity from the ruins of their past. Above all, the book is written with a simplicity that in no way detracts from its authority.

These two are the best books of the lot, there is no need to say more about them. It is a pity there were not more of the same standard, for then I could the more easily ignore the rest.

We might end by a final word of warning against Lyn Harrington's *China & the Chinese* (Nelson, $3.50), which could pass as pure propaganda for the Republic, but not as a book that can claim to be in the least way interesting or authentic. It is charitable to suppose that it is written out of ignorance, but that only makes it all the more dangerous. It exhibits all the worst qualities for a book designed to educate the young. It is pretentious, dogmatic, and utterly uncritical. Fortunately, I think, most of our young are bright enough not to accept such facile brainwashing.

Colin M. Turnbull

Astronomy

In the next few years men will be walking on the moon. Many of the readers of today's astronomy books for young people will participate in various ways in its exploration, and as citizens paying for their efforts, the rest of us should have a reasonable knowledge of the nature of the moon. We should be able to understand the reasons for such a literally far-out program. Responsible books introducing the moon to young and old alike should be encouraged. Two of the astronomy books reviewed this year concern the moon but are not sufficient to serve the purpose I have just suggested.

The Moon in Fact and Fancy, by Alfred Slote (World, $3.95), is interesting from a thematic point of view. According to a descriptive paragraph at the back of the book, Mr. Slote is experienced in telling youngsters a good story. In this book the author tells legends about the moon and alternately balances them with astronomical knowledge. While I cannot vouch for the authenticity and accuracy of the legends gathered from all over the

Continued on page 66

Trance Cure of the !KUNG BUSHMEN

by Richard B. Lee

"Bushman medicine is put into the body through the backbone. It boils in my belly and boils up to my head like beer. When the women start singing and I start dancing, at first I feel quite all right. Then in the middle, the medicine begins to rise from my stomach. After that I see all the people like very small birds, the whole place will be spinning around and that is why we run around. The trees will be circling also. You feel your blood become very hot just like blood boiling on a fire and then you start healing. When I am like this [*telling the story*] *I am just a person. The thing comes up after a dance, then when I lay hands on a sick person, the medicine in me will go into him and cure him."*

The speaker, whose words I have translated, is a Bushman. The !Kung Bushmen, a non-Bantu, click-speaking (the exclamation point stands for a click sound) people of the Kalahari Desert in Botswana, are one of the ast peoples of the world to maintain a hunting and gathering way of life —until 10,000 years ago, the universal mode of human organization. ccording to the Bushman belief, each tribe and race in the world has a distinctive kind of medicine. The Bantu medicine consists of witchcraft and sorcery. The European nedicine is contained in pills and in ypodermic syringes. The Bushman nedicine, or *n/um,* is a physical subtance that lies in the pit of the tomach of the *n/um kausi,* or 'medicine owner." Medicine was iven by God to Bushmen in the beginning, but men can transfer medicine from one body to another; this, in fact, is the main reason why Bushman trance dancers cure by laying on of hands on patients or subjects and by rubbing sweat. Normally medicine lies dormant. It is necessary to dance in order to heat it up. In their view, dancing makes the body hot. When the medicine reaches the boiling point, the vapors rise up through the spinal column, and when the vapors reach the brain, the dancer enters trance.

The dance ordinarily begins in the evening when a handful of women light a central fire and begin to sing. The dancing circle has a tight, symbolic organization. In the center is the fire, representing medicine, which must be kept burning throughout the all-night dances. Surrounding the fire and within the circumference of the circle. the women sit shoulder to shoulder facing inward. The women are primarily singers, dancing only occasionally. The men dance in an outer, circular rut, stamping around and around hour after hour, now clockwise, now counterclockwise. Beyond these two tight circles of singers and dancers sit the spectators—the children and those dancers who have paused and are temporarily resting.

The songs are sung without words, in the form of yodeling accompanied by syncopated hand clapping. There is a generally known repertoire of about ten named songs, each commemorating game animals or natural phenomena, such as the giraffe, rain, God, and mongongo nuts. Each has a recognizable tune and associated dance steps. However they do not attempt in the dance to imitate the behavior or locomotion of animals.

Phase I—Working up
Chaxni Chi (*"dance and song"*)

Soon after the women begin singing, some of the men enter the circle to dance. They maintain a tightly hunched posture, arms close to the sides and semiflexed, there is a parsimony of movement, and the body is held stiff from the waist up. Short, heavy footfalls describe complex rhythmic figures built on quarter- and eighth-notes and formed into five- and seven-beat phrases. Artifacts of the dance include chains of rattles tied around the ankles, a walking stick to support the torso, and an indispensable fly whisk.

A dance lasts from five to ten minutes, with a short break followed by another dance of equal length. The women determine the beginning and end of each number and the choice of songs. For the first two hours of dancing the atmosphere is casual, even jovial.

Phase II—Entering a trance
n/um n/i n!uma
(*"causing medicine to boil"*)

Several of the dancers appear to be concentrating intently; they look down at their feet or stare ahead without orienting to distractions around them. The body is tense and rigid. The footfalls are heavy and the shock waves can be seen rippling through the body. The chest is heaving, veins are standing out on the neck and forehead, and there is profuse sweating. This phase lasts for thirty to sixty minutes.

The actual entrance into trance can be gradual or it can come suddenly. In the first instance the trancer staggers and almost loses balance. Then other men, who are not in trances. come to his aid and lead him around in tandem until the trancer shouts and falls down in a comatose state—called "half-death" by the Bushmen. The sudden entrance is characterized by a violent leap or somersault and an instant collapse into the half-death.

Phase III—Half-death
Kwi ! ! (*"like dead"*)

Now the trancer is stretched out on the ground outside the dance circle. While the others continue dancing,

nen, as well as men, have power
ure. A medicine woman, behind,
s her subject into trance.

some men work over the trancer. They rub his body with their hands and with their heads so that the body is kept warm and made to shine with sweat. The trance performer is rigid, arms stiff at the sides or extended. His body may tremble, and he moans and utters short shrieks.

Phase IV—Active curing
n/um (*"medicine"*)

The culmination of the trance episode occurs when the performer rises up to move among the participants and spectators to "cure." The technique used is laying on of hands. The performer's eyes are half-closed. He rubs the subject with trembling hands and utters moans of rising intensity, punctuated by abrupt, piercing shrieks. The trance performer goes from person to person repeating this action, ensuring that every person present is treated. He may break off curing to dance for a few minutes. This appears to reinforce the tranced state and to forestall a premature return to a normal state. If there is a sick person present at the dance each trance performer will make a special effort, often giving ten or fifteen minutes worth of treatment to this one individual.

When trance dance begins, above, the mood is more social than sacred. Later, below, it grows more serious as men, some with magical ankle rattles, wear a groove in the sand.

Phase V—Return to a normal state

The active curing phase lasts about an hour, after which the trance performer usually lies down and falls asleep. It is common for medicine men to have two trance episodes per night, one about midnight and the other just after dawn. The dance continues all night, reaching a peak intensity between midnight and 2:00 A.M. when the maximum number of medicine men are in trance. It slackens off in the predawn hours and then builds up to full strength again at sunrise with a renewed round of trances. The dance continues until midmorning and usually terminates by 10:00 or 11:00 A.M. Some memorable dances, however, continue throughout the day and into the following night, terminating thirty-six hours after they have started. What makes these marathon dances possible is the change-over of personnel. Although there are always ten to thirty people actively participating in the dance, individuals are constantly

tering and leaving the circle in
ur- to six-hour shifts.

Apart from a male initiation cere-
ny, called *choma,* which takes
ace every four or five years during
winter, the Bushmen have no
remony that is tied to the annual
cle, such as the first fruits rituals of
Australian aborigines. The Bush-
n dance at all seasons of the year,
nter and summer, with no discern-
e changes in frequency. There are,
wever, marked differences between
arate Bushman camps in the fre-
ency of occurrence of dances.
all camps of fewer than twenty
ople hold dances about once a
nth. Large camps with forty to
ty people dance about once a
ek. At one camp, which had a rep-
ation for fine music, dances
curred as often as four nights a
ek. There is some indication that
Bushmen prefer to dance at the
e of the full moon, but I could
cover no reason for this prefer-
ce beyond the simple fact that the
light is better. A dance is a major all-night affair that involves the majority of the adult members of the camp. It is worth noting that the dance is a social and recreational event as well as an opportunity for trance performance. Many of the younger men dance for no more profound reason than to show off their fancy footwork. There is a juxtaposition of the sacred and the profane in the dance, with the intense involvement of the trance performers contrasting with a background of casual social chatter, laughter, and flirtation.

A dance will spring up spontaneously if the informal organizers can talk up enthusiasm for it. Three kinds of circumstances favor its initiation: the presence of meat in a camp, the arrival of visitors, and the presence of sickness in a camp.

The trance phenomenon of the Bushman is a culturally stereotyped set of behaviors that induces an altered state of consciousness by means of autosuggestion, rhythmic dancing, intense concentration, and hyperventilation. These exertions produce symptoms of dizziness, spatial disorientation, hallucinations, and muscular spasms. The Bushmen were never observed to use any drug or other external chemical means of inducing these states. The social functions of the trancers are to cure the sick, influence the supernatural, and provide mystical protection for all members of the group.

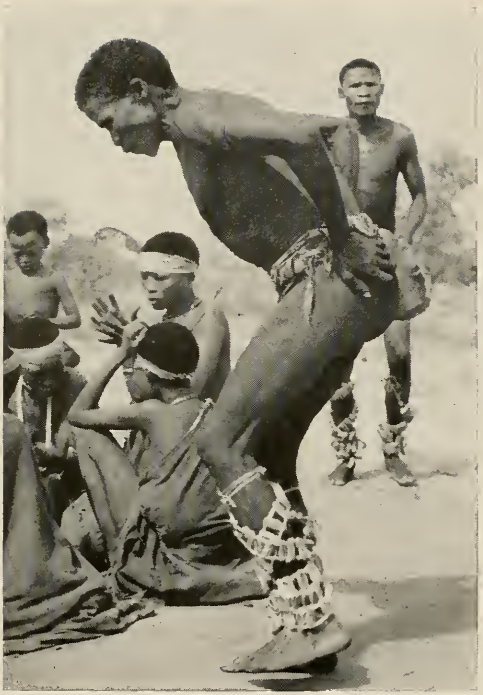
The key symbols and metaphors that are found in the Bushman trance complex are the concepts of boiling, fire, heat, and sweat.

Boiling (*n!um*—to boil) refers not only to the boiling of water on the fire but also to the ripening of plants. Water, like medicine, is dormant when cold, but powerful when hot. Similarly plant foods are dormant when young and unripe but become nutritionally potent when ripe. Thus there is a symbolic association of boiling water, cooked meat, ripened berries, and activated medicine. Sometimes this metaphor is extended, in a joking manner, to nubile maidens who have reached menarche. These young women are now considered "ripe" for intercourse and impregnation.

Fire (*da*) is the source of heat (*khwi*) for boiling water, cooking meat, and for activating medicine. The central fire symbolizes medicine, and rubbing of live coals on the body, which is often done, was interpreted by one informant as a means of rapidly incorporating the sources of medicine. Another informant interpreted fire rubbing as a means of heating up internal medicine. These two views are not necessarily contradictory. Trance performers use the same word (*da*) to describe both the central dance fire and the fire within their own bodies, which heats up the medicine.

Sweat (*cho*) is the most important of the trance symbols for it is the palpable and visible expression of medicine on the surface of the body. Sweat is symbolically equated with the steam rising from boiling water and with the vapors that rise from the medicine boiling in the pit of the stomach.

The production and transmission of sweat is the key element in the curing ritual. Illness is lodged at



sites on the body of the sick person and can be driven out by the implanting of medicine.

There is an important contrast to be made between Bushman sweat symbolism and that of the sweat lodge and sweat house religions of North American Indians. In these rituals sweating is interpreted as a means of purification of the body. The perspiration, therefore, carries the negative or harmful substances out of the body. The Bushman belief specifies the opposite—the sweat is itself the positive and life-giving substance. In the sweat house it is necessary for the patient to perspire in order to be cured. In the Bushman case only the curer must sweat in order for the medicine to be effective.

The act of curing involves the laying on of hands, and the rubbing of medicinal sweat onto and into the body of the sick person. If the patient complains of chest trouble, the curer's attention will be focused there; similarly with other complaints located in specific organs, the curer will work on the afflicted part. In this ritual it is not necessary for the patient to enter trance in order for the cure to be effective. Often three or four curers will work simultaneously or in shifts on the body of a sick person. Thus there is no concept of individual responsibility if the cure is successful or unsuccessful. A demand of payment for the curer's service is not a common feature among the Bushmen, although some curers do receive payment when they are called in to give treatment to neighboring Bantu peoples.

In addition to healing, another class of powers attributed to the trance performer is the ability to see the ghosts of ancestors, to see at a distance, and X-ray vision.

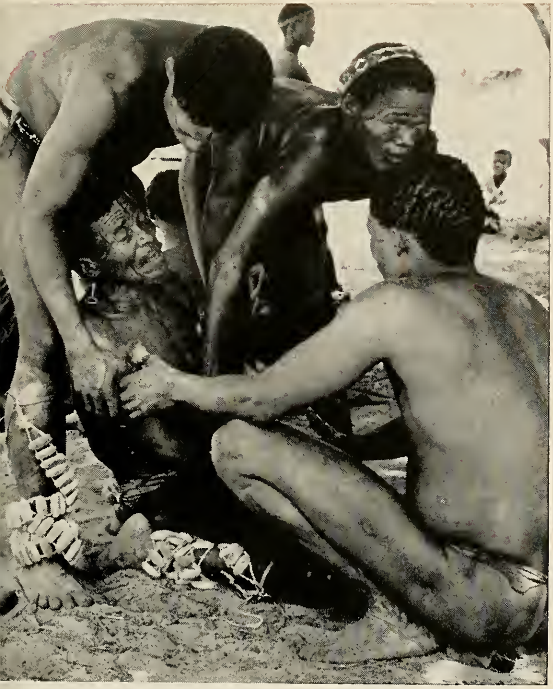
Spirits of the dead may be responsible for causing sickness. The ritual curer in trance is able to see the shade hovering at the edge of the dance circle. These shades are invisible to all but the most experienced curers. Having diagnosed the source of the illness the curer then pleads with the ghost to make it go away. The following chant is used:

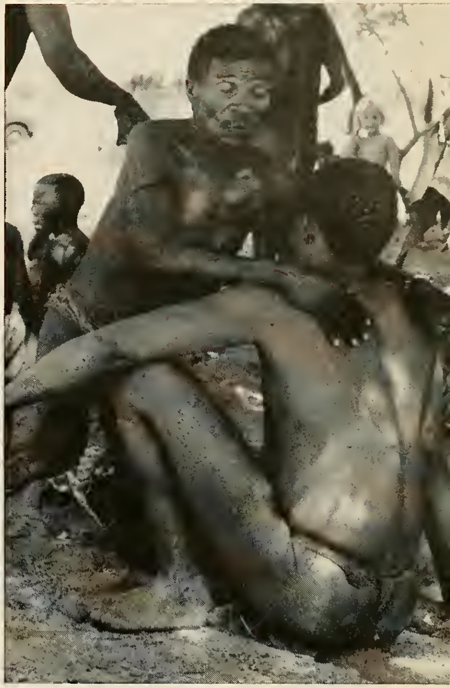
> Why do you bother this one?
> Go away and don't trouble us;
> We love this man.
> What have we done to you?

Some trance performers claim ability to see distant scenes. On occasion a performer stopped curi walked to the edge of the circl firelight and facing north descri the scene at a Bantu village f miles away. On another occasio performer pointed to the horizon announced that trouble was com from the west. (As far as I kno never materialized.) This power commonly attributed to trance formers, although I rarely obser it to be exercised.

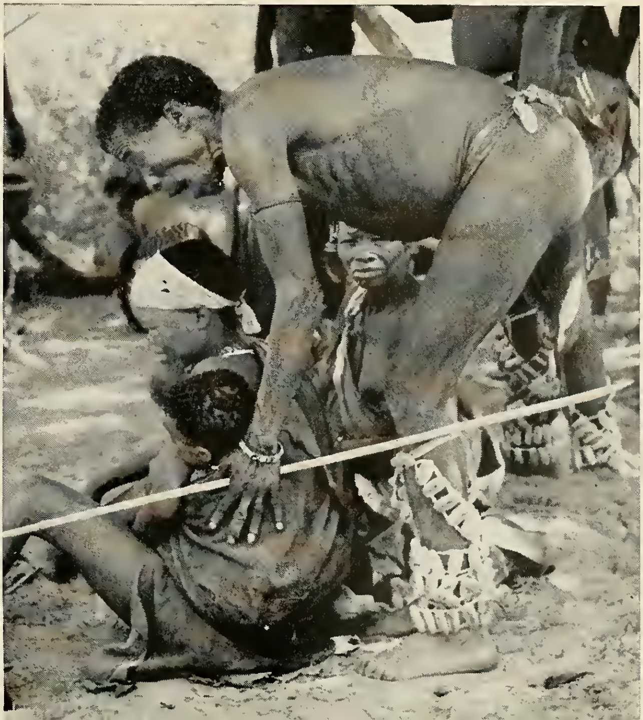
X-ray vision takes the form of termining the sex of infants *in ut* I lack a statistically significant s ple of these predictions (only births occurred during the st period), so I cannot judge the e tiveness of this technique.

The Bushmen believe that, in past, a few of the very powe curers had the ability to transf





A dancer, wearing a sardine key
n his ear, works into trance in the
ckwise sequence beginning at far
left. Near "half-death" in the
ond photograph, he is guided by
a fellow dancer until he collapses.
few moments later, he rises from
his comatose state and transmits
"medicine" by the laying on of
ands. He treats his assistant first,
then a woman and her child.



mselves into lions and to stalk the
ert in search of human prey. Lions
linarily do not attack men, and
nters occasionally drive lions off
sh kills in order to scavenge the
at. On the several occasions when
on has attacked a man, the Bush-
n attributed the attack to a human
er-turned-lion. Since such inci-
its occur perhaps once or twice in
ecade, there is little reinforcement
the belief in the malevolence of
nce performers.

t is instructive that, apart from
belief. all of the !Kung folk be-
s about trance performers assign

to them a benevolent, positive, and socially constructive role.

This positive evaluation of the trance performer's role is most clearly demonstrated in the offering of mystical protection. It is the performer's duty to lay hands on all who are present at a dance, including men, women, children, and young infants. Thus one sees the curers moving around the dance circle and through the spectators, treating each individual in turn, even though there is no sickness in the camp.

The !Kung Bushman trance complex resembles in some ways the classic shamanism of Siberia and native North America. Both the Bushman and the shaman complexes emphasize individual trance as a means of activating extraordinary healing powers. In addition the trance complex as a system of explanation of misfortune has some correspondence to the institution of witchcraft found in many non-European societies. However, the Bushman case differs from shamanism and witchcraft in critical areas.

The well-known distinction between the shaman, whose powers derive from direct contact with the supernatural, and the priest, who learns a codified body of ritual knowledge from older priests, is blurred in the Bushman context. Unlike the shaman who contracts directly with the spirit world, the Bushman trance performer derives his power from within the social body itself.

The Siberian shaman, to take one example, is a lone figure whose power comes from "spirit possession." This supernatural contract—he has entered into a pact with the supernatural—tends to alienate the shaman from his community, and it is significant that the shamanistic role serves as an outlet for emotionally unstable individuals. In American Indian societies, such as the Pawnee, the shamans as a group are set off from the community in a formal fraternity of medicine men. In a number of African societies the shaman may assume the role of an authoritarian prophet figure and may gather a considerable following around him. In all these cases the medicine men are collectively and individually regarded by the laity as awesome and potentially dangerous.

The Bushman trance performer, by contrast, maintains strong social ties with the community. Indeed, recruitment and training of performers forges bonds of affection between the novice and his mentors, and between the curers as a group and the rest of the community. The Bushman curers do not form an exclusive minority of unusually gifted men, nor are they organized into a secret society with special access to the mysteries. The ability to enter trance and cure is possessed by half of the adult men (and by a number of the women).

This close identification of the trance performer with the community at large becomes evident when we consider the logic underlying the Bushman conception of the sources of healing power and the sources of misfortune. The Bushmen regard the healing power as being derived from other living men. Illness and misfortune, however, are brought mainly by the spirits of the dead and other forces external to the living. In other words they seek within the social body for benevolent powers, but project the blame for malevolence to forces outside of the social body. Such a conception of health and disease serves to bind together the living in a common front against hostile external forces.

Societies in which sorcery, shamanism, and witchcraft are prevalent divide good and evil into a radically different projective system. In

Dawn breaks on an intensive round of trance curing, which has lasted the entire night.

ese societies, malevolence springs om within the social body as well from without. Witches, sorcerers, ıd wizards are all conceived of as ing humans who (willfully or not) use harm. To combat this malevo- ıce, the individual may resort to e services of another sorcerer mpathetic to his cause. It is true at in witch-oriented societies not evil is defined as coming from the ing. However, the logic of the sys- n leads inevitably to such features good and bad shamans, good and d sorcerers, and a spiral of magi- l attack and counterattack.

When misfortune strikes a mem- r of a witch-oriented culture, he is ely to seek its source among the ing members of the community. many cases the prime suspects are individual's close relatives. The stility that is an inevitable by- oduct of interpersonal relations is ıs translated from the profane into realm of the sacred. Nevertheless hostility must be absorbed gely by the social body. The Bush- n, simply by attributing misfor- ne to an external source, have olved a projective system that dis- ates, rather than intensifies, inter- rsonal hostility.

It would be misleading to allow reader to draw the conclusion that all the problems of social living are resolved by the Bushmen in the trance performance and its associated system of explanation. Although the role of "witch" is not an institution of Bushman society, there is a prevalent belief that a living man can (willfully or unknowingly) cause harm to others by neglecting to propitiate his ancestors.

I cite a case in which two old men, Kumsa and Neysi, had been feuding with each other over a period of years. Once, when Kumsa became ill, he complained that Neysi was indirectly the source of his difficulty. This accusation of witchcraft took the following form.

> Neysi has spoken ill of me. His ancestors have overheard these words and now they have come to bother me. Why can't Neysi control his ancestors?

In order to clear himself of the charge, Neysi was required to come to Kumsa's bedside and to plead publicly with his offending ancestors to leave Kumsa in peace. In this ritual of reconciliation Neysi used an incantation that is similar to that used by a trance performer when he sees a ghost hovering at a dance.

> This territory here is ours to share. Now the ghosts should just go away and let this man live in peace. . . . Because of my words the ghosts are trying to kill Kumsa. Now I say—Kumsa is my child. Ghosts! Go away!

However, this incident was an isolated occurrence; by far the more common attribution of malevolence was to a ghost who was acting entirely of its own volition—uninfluenced by human manipulation.

In conclusion, the attainment of a trance is a co-operative enterprise involving both women and men. The trance performance itself is characterized by a lack of secrecy and a high degree of mutual aid. The psychological rewards of the trance experience are available to a high percentage of the adult men of the community. All members including women and children enjoy the benefits offered by the mystical protection of the curer. The socially positive evaluation of the trance performer's role in society is congruent with the Bushman belief that misfortune springs largely from the dead, and not from the agency of living men. The !Kung Bushman trance performance can be regarded as a drama in which the stresses and tensions of social life are transformed into a common struggle against the external sources of malevolence.

GRAND CANYO

by BROOKS ATKINSON

From the lofty platform of the South Rim, the Grand Canyon looks transcendently beautiful. Against the radiant blue of the Arizona sky it draws up out of the depths of the inner gorge and sweeps across the distant plateaus like an intricate composition in blue —pastel blue in the limestone lintels that form the flat horizon; dark blue in the hidden trench where the Colorado River noisily wears a track through the earth's crust.

Beauty is in the eye of the beholder, and millions of people throughout the world know that the Grand Canyon is uniquely beautiful. But the beholder must also acknowledge the Grand Canyon's indifference. The dimensions are too vast to be assimilated into a human scale. The canyon is 217 miles long. It is, at places, a mile deep. The time values are even more overwhelming. The canyon contains rocks two billion years old. One of the latest organic events that took place there occurred ten million years ago when the Colorado River, still classified as a "young river," started flowing through its present channel.

To a mammal that stands only five or six feet high and traditionally reckons its years at threescore and ten, these figures are beyond understanding. In the Grand Canyon time is unlimited, a phenomenon that we can hardly comprehend.

We can, nevertheless, soothe our shattered egos by one piece of rationalization. Although modern men with scientific training are the last of the mammals to enter the canyon, they have gotten the most out of it. They have used it as if it were a gigantic laboratory. By exploring it—always with difficulty, often with danger—they have succeeded in making legible a vivid chapter in the history of the earth. So far, men have been at their best in the canyon—inquiring, persistent, disinterested. What they have learned is pure knowledge, beyond price and immune to materialistic manipulation. Up to the present time, that is, for promoters with nothing except materialistic motives have a plausible scheme for turning the Colorado River into a source of revenue. Even the Grand Canyon is not exempt from human greed.

By the geologic clock, scientific research i canyon has taken only an instant. Lieutenant Jose led the first geologic expedition there 109 years ag tematic knowledge of the canyon began even late than a century ago—when John Wesley Powell, of science as well as adventure, led a party of b through the canyon for the first time in history a removed it from folklore and mystery. Looking upturned rocks of the gorge he knew the signific what he was seeing. "The book is open, and I ca it as I run," he remarked when he was camping beach (which is still there) at Bright Angel Creek he named). The open book he was reading is the of almost half of the lifetime of the earth, for tha record that the Grand Canyon preserves. Eve about the canyon is remarkable. But nothing is m markable than the intelligence with which scienti laymen have used it.

Like a poem, the Grand Canyon *is*. It does no anything, in the way that the Washington Monume or the faces on Mount Rushmore do. But the sci the naturalists, and again the laymen have found in things that have great significance—grace note song of the earth. Every clump of eroding lim every streak of vermilion shale, every ripple ma mud crack, every cottonwood growing beside a sp creek, every cluster of yellow rabbitbrush, ever of agave rising out of a circle of bleached leave arid heat of the desert, every raven gliding o depths of the canyon, and every violet-green s racing across the rim and along the rock walls—e significance because enlightened men have und its place in the ecology of the region. Between th and South Rims and the cottonwood grove of P Ranch, a half mile back from the Colorado Ri Grand Canyon includes all stages of climate from to Canada. It is a natural encyclopedia.

Intelligent use of the canyon has come late boundless history because we, as a species, ha

ve it as it is. You can not improve on it. The ages have been at
k on it, and man can only mar it. Theodore Roosevelt

y struck some sort of working compromise with
: of nature. In 1826 a fur trapper who penetrated
ɜ canyon described its high places as "horrid"—
ative word that had been used to describe moun-
or centuries. In 1858 Lieutenant Ives made one
nt that has been held up to ridicule ever since. "It
ntended by nature," he wrote in his report, "that
lorado River, along the greater portions of its
and majestic way, shall be forever unvisited and
rbed." His use of the word "majestic" suggests
was not emotionally sterile, as is commonly as-
but that he regarded the difficulties of travel as
le. He could not foresee the complex and breath-
ss transit of today.

as Major Powell who changed everything eleven
ars later. A realist as well as a geologist, which
deed be the same thing, he cleaned out the last
: of the medieval point of view. We owe a great
this indomitable man not only because of what he
red but because of what he felt—his enthusiasm
s creative as his knowledge. Now the Grand Can-
he center of a civilization of its own. Every year
wo million people, American and foreign, visit it;
vo thousand run the river in rafts or boats that are
ıan Major Powell's. Every day fifteen or twenty
ride mules down the Bright Angel Trail—ten
own sharp grades—to the little pocket of nearly
civilization called Phantom Ranch; they return
: day up the fearful grades of the Kaibab Trail.
he canyon about two hundred Havasupai Indians
. raising grain, fruit, and vegetables on a small,
plain, where Havasupai Indians have lived for
ve hundred years. They preserve a simple culture,
ıey supplement by providing a few services and
rs for the tourists.

Throughout the year scientists and naturalists keep poking into the corners of the canyon in search of new facts or facts that confirm previous speculations. Since the canyon is so vast, these intrusions are hardly more than mobile specks on a measureless surface. But they show the extent to which men have managed to penetrate into a wild, inhospitable bowl that is like a sullen presence and that extorts exhaustion and thirst from all who use the hot, sandy, crisscross trails.

Since some of the Grand Canyon is a national park, and some of it a national monument, most Americans assume that it is—as it should be—inviolate. But when a dollar can be made, a way can be found to debase anything. The Colorado River is already dammed in several places. Commercial exploiters, routine politicians, and the Bureau of Reclamation, which has a heart of cement, would like to build at least one more dam that would control both the volume and the current of the river and, in one plan, back up water into the monument. For the Colorado River, which has been grinding its serpentine way through rock for ten million years, can be tamed into a sluggish stream or stagnant backwater. Since a dollar can be made this way, the arguments sound high-minded and plausible, and it is claimed that most tourists looking down from the rim would never know the difference.

But men with no respect for their country's heritage and no imaginative understanding of the nature of life should not be permitted to tamper with this living work of nature. The Colorado River is the sovereign engineer of the canyon and has had more experience than the Bureau of Reclamation. By studying the varied evidence of the canyon, geologists and archeologists have achieved something of priceless value: they have defined a true perspective on human life. We now have some idea of where we stand in the scale of universal values.

The true perspective on human life does not include tampering with the Grand Canyon for temporary profit. Against the blue grandeur of this immortal canyon, the acquisitive instinct of human beings is contemptible.

*All winter long, on its mountain-crested rim, snow falls, filling t
gorges, half burying the forests, and covering the crags and peaks wi
a mantle woven by the winds from the waves of the sea–a mantle
snow. When the summer-sun comes, this snow melts, and tumbles do
the mountainsides in millions of cascades. Ten million cascade broo
unite to form ten thousand torrent creeks; ten thousand torrent cree
unite to form a hundred rivers beset with cataracts; a hundred roari
rivers unite to form the Colorado, which rolls, a mad, turbid strea
into the Gulf of California.*

Quotations from John Wesley Powell

Photographs by Patricia Caulfield

ding down a short distance, a beau-ul view is presented. The river turns arply to the east, and seems enclosed a wall, set with a million brilliant ms. What can it mean? Every eye is gaged, everyone wonders. On com- nearer, we find fountains bursting om the rock, high overhead, and the ray in the sunshine forms the gems ich bedeck the wall. The rocks low the fountain are covered with sses, and ferns, and many beautiful wering plants.

There is an exquisite charm in our ri
today down this beautiful cañon.
gradually grows deeper with eve
mile of travel; the walls are symmetr
cally curved, and grandly arched; of
beautiful color, and reflected in t
quiet waters in many places, so as
almost deceive the eye, and sugge
the thought, to the beholder, that
is looking into profound depths. W
are all in fine spirits, feel very gay, a
the badinage of the men is echo
from wall to wall.

e gorge is black and narrow below,
l and gray and flaring above. . . .
wn in these grand, gloomy depths
glide, ever listening, for the mad
ters keep up their roar; ever watch-
, ever peering ahead, for the nar-
v cañon is winding, and the river is
sed in so that we can see but a few
ndred yards, and what there may be
ow we know not; but we listen for
ls, and watch for rocks, or stop now
l then, in the bay of a recess, to ad-
re the gigantic scenery.

tell the Indians that I wish to spend some months in their country
ring the coming year, and that I would like them to treat me as a
iend. I do not wish to trade; do not want their lands.... I tell them that
l the great and good white men are anxious to know very many things;
at they spend much time in learning, and that the greatest man is he
ho knows the most. They want to know all about the mountains and the
lleys, the rivers and the cañons, the beasts, and birds, and snakes.
hen I tell them of many Indian tribes, and where they live; of the Eu-
pean nations; of the Chinese, of Africans, and all the strange things
out them that come to my mind. I tell them of the ocean, of great
vers and high mountains, of strange beasts and birds. At last I tell
em I wish to learn about their cañons and mountains, and about them-
lves, to tell other men at home; and that I want to take pictures of
erything, and show them to my friends.

THE CANYON AND THE RIVER

by William J. Breed

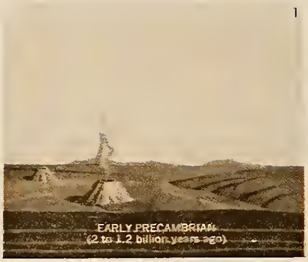
In other areas of the world the story of the past is incomplete, the rocks buried or removed by erosion, or so distorted by natural forces that their relationship with time is no longer decipherable. But at Grand Canyon a vast reality floods the scientific mind, compels it to explain, to re-evaluate old geologic theories and test new concepts. The most direct statement about the Grand Canyon is at once the most profound: this mighty trench reveals two billion years of earth history.

Many a geologist has scrambled along remote trails tracing and measuring rock units up and down and from one end of the canyon to the other, recording minute details of the layers, and searching for fossils and other clues to earth history.

From the limestones, sandstones, and shales of Grand Canyon, the imprints of ancient seas, deserts, and deltas emerge. Details of the rocks —ripple marks, mud cracks, raindrop impressions, and cross-bedding—define long-vanished shorelines, streams and their mountain headwaters, and compose a durable record of changing climates and evolving landscapes.

At the bottom of the canyon, where one can see some of the oldest rocks in the world, there is no evidence of life, although rocks of similar age in Canada contain primitive life be-

The volcanic lavas and sediments laid down during the Early Precambrian (1) were folded and metamorphosed as molten material invaded from below (2). The high mountains thus formed eroded away and new layers of sediments accumulated, which were then injected with molten material (3). Fault-block mountains formed as these layers were broken and tilted (4). Erosion reduced the mountains to a plain, leaving as remnants only ridges (5). The deposition, with erosional intervals, of two major sedimentary layers followed (6). Most of the second layer, the Mesozoic, eroded away and only a thin covering remained (7). The Colorado River established westward drainage in the Cenozoic and began to cut into, and expose, the older rocks (8). The dominant process of this era has been erosion, although volcanic activity in the last million years has left scattered peaks and cones.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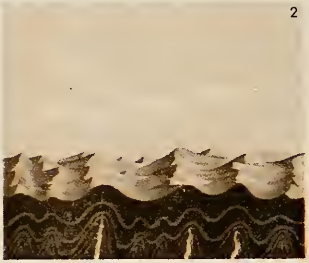
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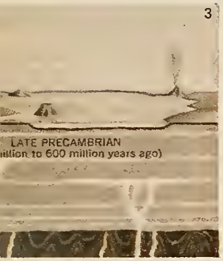
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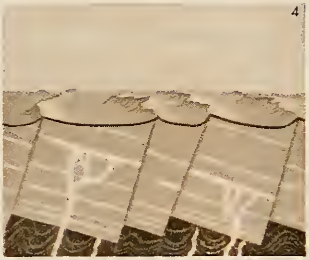
LATE PRECAMBRIAN
illion to 600 million years ago)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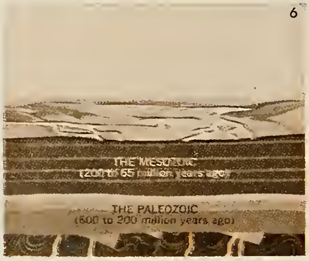
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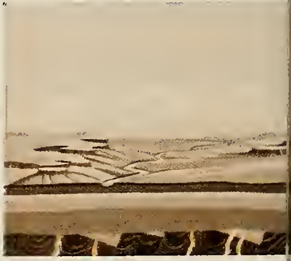


lieved to be bacteria or algae. Next in ascending order, the Early Precambrian rocks have yielded jellyfish-like fossils and banded algae. Many diverse types of fossils are in the Paleozoic rocks—trilobites (primitive crustaceans much like horseshoe crabs), primitive armored fish, amphibian and reptile tracks, and primitive gymnosperms such as conifers and ferns. The Mesozoic rocks of the Navaho Reservation contain tracks and bones of huge dinosaurs and other reptiles and amphibians; in the upper layers are found angiosperms—the flowering plants that are dominant today. The Cenozoic rocks of the canyon contain mammal bones, and the most recent deposits show evidence of man's presence. The story of evolution is thus beautifully unfolded as one progresses from the older to the younger rocks.

Despite the canyon's geologic readability, one question has not been fully answered, even after 100 years of speculation and study. Precisely how was this huge chasm cut into the rocks of the Colorado Plateau? The earliest answer was suggested by John Wesley Powell in 1869. His idea was that the river originally flowed over a lowland, long before the plateau area was uplifted. Folding and faulting caused the land to rise, and the river, keeping pace with the uplifts, cut Grand Canyon somewhat as a knife would cut a cake if the cake were lifted upward against the blade. This theory, so beautifully simple and easy to explain, lost its validity when later geologists discovered that the folding and some of the faulting that raised the plateau occurred long before the river existed.

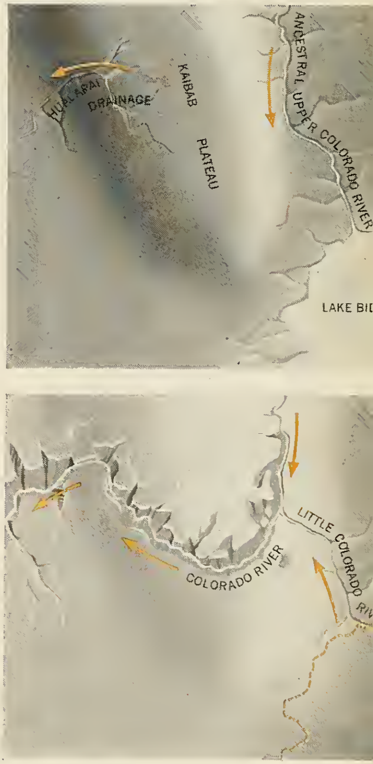
To circumvent this difficulty, several geologists, including the famous William Morris Davis of Harvard University, reasoned that the river must have begun its course upon a covering layer of sedimentary rocks that had buried the folded and faulted structures. Renewed uplift of the area then gave the river gravitational impetus to cut through and expose the old, underlying structures. This theory of superposition was widely held for many years, but evidence to support it, in the form of remnants of the supposed sedimentary cover, has never been found.

The Colorado River begins in the Rocky Mountains, which have been in existence at least since earliest Cenozoic time—some 65 million years ago. Yet the river below Lake Mead, where it forms the border of Arizona, is less than 10 million years old. This age, suggested several decades ago by Dr. Chester Longwell, was confirmed in 1964 by measurements of the potassium-argon ratio in rocks from volcanic eruptions that covered the earliest known sediments deposited by the Colorado River along its lower course. Such an enormous discrepancy in the ages of the Upper and Lower Colorado needed to be resolved in any theory that presumed to explain the history of the river and the cutting of Grand Canyon.

The latest attempt to reconcile conflicting bits of evidence from different parts of the Colorado Plateau is expressed in a hypothesis conceived by a group of 21 geologists who met at the Museum of Northern Arizona, Flagstaff, under the chairmanship of Dr. Edwin D. McKee, during the summer of 1964. Their idea is that two river systems existed independently on the plateau during most of Cenozoic time. The eastern system, called the ancestral Upper Colorado River, flowed southward from the Rocky Mountains, but came into Arizona only as far as eastern Grand Canyon, where it turned southeastward and flowed into New Mexico. The other system, the Hualapai, flowed westward from a great domed area, the Kaibab Plateau, that separated the two systems. As a waterfall will gradually consume the ledge over which it flows, the headwaters of the Hualapai system cut back through the dome until the system reached and captured the ancestral Upper Colorado. The two systems were united to form the modern Colorado River, whose rushing waters then flowed westward across Arizona and cut deeply through the domed area, forming Grand Canyon.

A unified picture of earth history at Grand Canyon is slowly, obdurately coming into focus—a feat that would be consummately difficult to achieve in less exposed segments of the earth's crust.

8
THE CENOZOIC
65 million years ago to present)



About 35 million years ago, the drainage pattern in northern Arizona was determined by the Kaibab Plateau, which separated the generally eastward-flowing ancestral Upper Colorado River from the westward-flowing Hualapai drainage system (upper diagram). Lake Bidahochi was formed when a land uplift blocked the river's flow. Headwater erosion gradually extended the Hualapai drainage eastward until, about 10 million years ago, it captured the Colorado and caused its waters to flow westward (lower diagram). The river subsequently carved deeply into the Kaibab Plateau, forming Grand Canyon; sediments, meanwhile, filled Lake Bidahochi.

SKY REPORTER

Scientists from 43 different countries met in Prague at summer's end to exchange notes at the International Astronomical Union.

International politics intruded briefly when Soviet astronomers offered a map of the far side of the moon containing 228 new names. American astronomers immediately argued that name assignments should wait for improved maps that will become available as a result of the Orbiter 5 photographs. A showdown was averted when Dr. Aleksander A. Mikhailov, director of the Pulkovo Observatory, agreed to designate craters and other features by number until better maps from several countries are prepared.

Perhaps the most intense scientific excitement at the conference was caused by discussions of interesting hydroxyl emissions received by radio telescopes, which seemed to meet criteria for signals of intelligent origin.

Hydroxyl is a molecule composed of a single atom of hydrogen and one of oxygen. Although it exists in space, it is almost impossible to work with in a laboratory because it reacts immediately with anything with which it comes in contact.

While the possibility of intelligent origin was by no means discarded, Dr. I. I. Shklovskii of the Soviet Union offered the alternative explanation that the unusual hydroxyl emission was the result of clouds of dust and gas condensing into new stars.

Intensive observations are planned of all known hydroxyl sources within our Galaxy, with emphasis on a search for variations in the emission patterns that may indicate the source of the signals received by the radio telescopes.

EXPLORING IN INFRARED

Serendipity does not occupy the same exalted position in physics textbooks as, say, the laws of thermodynamics, but scientists welcome this phenomenon as warmly as anyone else.

Astrophysicists piecing together the story of stellar evolution have long sought very cool stars in the first stages of contraction. Such cool objects characteristically radiate most strongly in the infrared portion of the spectrum, and this is where the search has gone on, with the aid of electronic detectors in all parts of the world.

Cool stars have been located with this method, but the evidence now indicates that in nearly all cases the radiation that they give off is being reddened by passage through extremely dense clouds of dust, which reinforces the cool signal received and makes the stars themselves appear cooler than had been thought. This effect has given astronomers new measurements on the density of the dust, a key ingredient in the formation of new stars.

This finding has led to the belief that the light from some stars is being reddened by interstellar matter that remained around the star after it was formed. Astronomers now feel that these clouds will condense in turn into planetary systems like ours.

A search for stars in the making thus appears to have resulted in the discovery of planets in the making. No one seems to be complaining.

John P. Wiley

CELESTIAL EVENTS

Morning skies present the best planet display this month. Just before dawn, Jupiter is high in the south among the stars of Leo, and Venus is well up in the east, by far the brightest object in the sky, except when the moon is present. Mercury may also be seen in the morning sky with relative ease between the 10th and the 25th, when it will be in the southeast near the bright star Spica.

Observers with keen eyes, and those with optical equipment, should try looking in the morning sky for the planet Uranus, about sixth magnitude, near the bright planet Venus. Uranus will be to the left of Venus during the first week of the month; just above Venus on the 7th (too close to be seen without optics), and to the right of Venus thereafter.

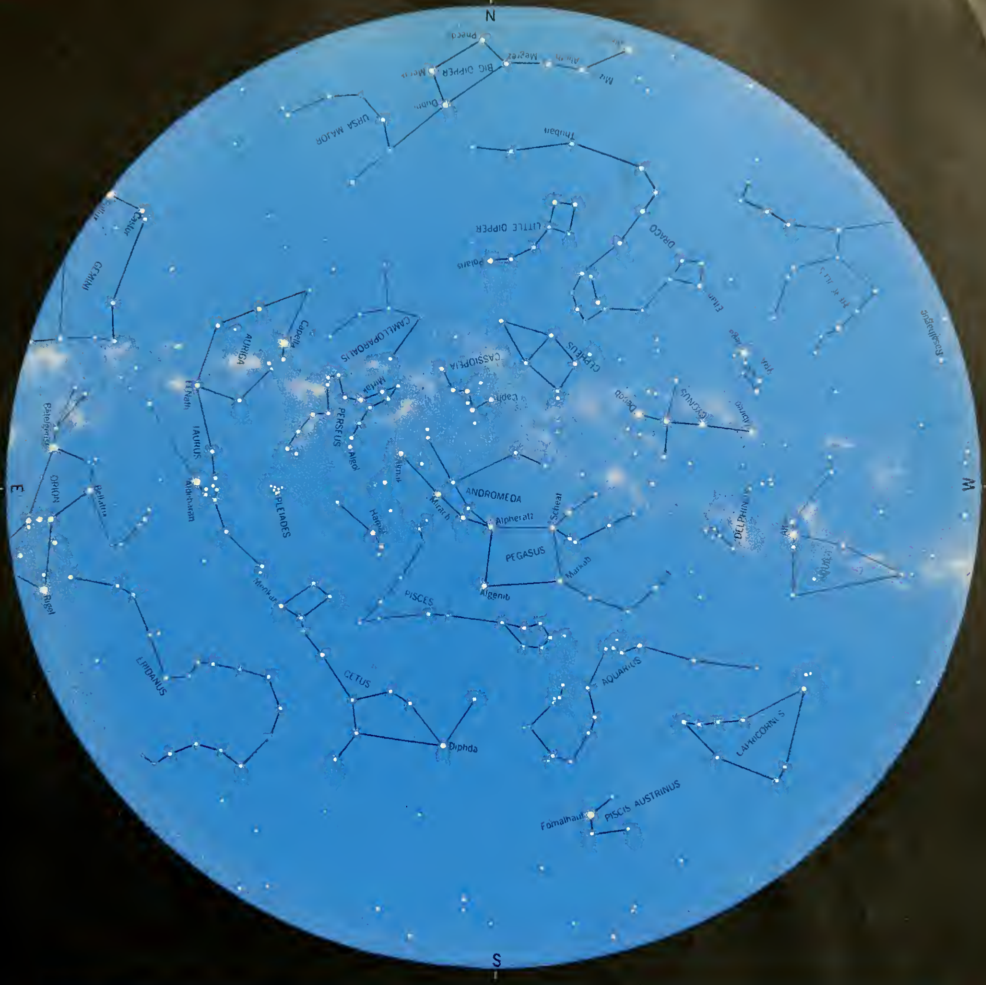
In the evening sky, Mars appears low in the southwest and Saturn high in the east after nightfall. Mars sets soon after dark, but Saturn remains visible almost until dawn.

The Leonid meteor shower is expected to reach maximum at about 1:00 A.M., EST, on November 17. The shower normally produces 15 to 25 meteors per hour, and considerably less on the nights before and after maximum occurs. The Leonid meteors are often very bright, although the presence of the moon on November 17 will detract from the display.

This famous shower produced an unusual display of meteors and fireballs last year, observed generally throughout the western United States, the first such display from the Leonids since 1866. In past years when this shower has been outstanding, far better than normal showers were seen in the years before and after the great storms. Thus it is quite possible that this year may also produce an exceptionally heavy, perhaps spectacular, display of meteors.

Thomas D. Nicholson

Hold the star map so the compass direction you face is at the bottom; then match the lower stars with those in the sky near the horizon. The celestial events chart shows times of rising and setting of the sun, moon, and principal planets; times of twilight; and sundial correction during the month. The horizontal scale shows time; vertical scale shows dates. The top strip locates bright stars, planets, and the moon within the zodiac. The horizontal scale of hours shows the time when planets and certain stars are due south and highest at midmonth. The different phases of the moon shown are due south and highest on the dates indicated.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Vega
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CASSIOPEIA
Caph
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PERSEUS
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PEGASUS
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CETUS
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ERIDANUS
GEMINI
Castor
Pollux
ORION
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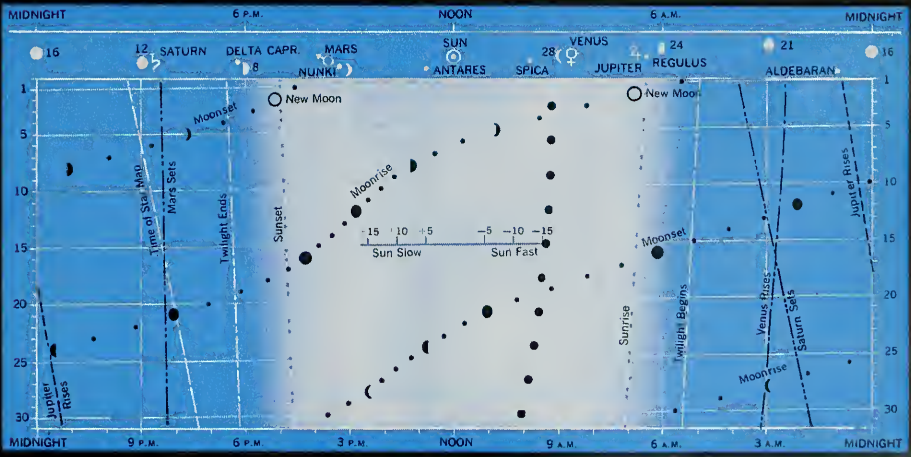
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6 A.M.
MIDNIGHT
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12
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SPICA
28
VENUS
JUPITER
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REGULUS
21
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16
1
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New Moon
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Moonrise
Time of Star Map
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Twilight Ends
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Sunrise
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Jupiter Rises
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9 A.M.
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MIDNIGHT

Geomagnetism and Animal Orientation

by John D. Palmer

Do the guidance systems of animals respond to the earth's magnetic forces?

By the first century A.D., the Chinese had already learned that if they suspended an elongate piece of lodestone by a string around its center, one end of the stone would always point approximately north. Thus was born the first "leading stone," or compass—one of the most important and useful navigational instruments ever devised by man. The compass needle's penchant for north is, of course, an ineluctable response to the magnetic "lines of force" that emanate from and encircle the earth.

On discovering that many kinds of animals (birds in particular) were able to navigate over the surface of the earth, some of the more imaginative zoologists began to wonder whether these animals might possibly possess some equivalent of the mariner's compass within their bodies. As preposterous as such an idea might have seemed, the desire to solve the mystery of animal navigation was great enough to entice several investigators into examining this possibility.

Each year more than 100 species of birds in the United States alone migrate to and from their wintering grounds located mainly in the West Indies and Central and South America. Many of these migrants fly thousands of miles on their round-trip voyage. For example, the Golden Plover flies non-stop at about 60 mph for a distance of 2,400 miles; only two ounces of body fat are burned during the whole trip. (If a man could build an airplane that would work with the same proportional efficiency, it could fly eight times farther than normal on a tank of fuel.) A more extreme example is the Arctic Tern, which undertakes an annual circumpolar migration between the Arctic and Antarctic, a round-trip of up to 22,000 miles.

One of the striking features of these long-distance migrations is that the birds may have specific destinations, and barring incapacitating mishaps during their rigorous flights, navigate precisely to a desired area. How they are able to do this has puzzled scientists for years.

The eyesight of birds is very good, and they certainly use this sense to follow major topographical landmarks on the surface of the earth. It has been shown, for example, that homing pigeons must first make short sorties, and then longer ones, in order to memorize the neighborhood before they are able to make long-distance return flights. Experiment has shown that once this task has been accomplished, some birds are capable of homing from 500 miles away in a single day. When a locale has been learned it is remembered for a considerable period of time. Should the countryside be altered by a cover of snow, however, the birds often lose their way.

But there is much more to bird navigation than learning to recognize landmarks. The first southerly emigration of newly hatched birds is to a wintering area never before visited. While it is quite possible that these naïve birds simply accompany older ones that have made the journey before, this is not necessarily the case. In experiments where young crows, Blue-winged Teals, and White Storks were held captive until all the experienced adults had emigrated, banding and recapture experiments proved that these inexperienced birds also reached the wintering ground when finally liberated. Certainly, at least in these tested species, knowledge of the migratory route must be hereditary.

It has recently been shown that birds also have an inborn ability to use the sun as a celestial guidepost in their flights. Starlings, for instance, can maintain a northerly orientation at midday by flying directly away from the sun shining overhead in the Southern Hemisphere. Because the sun is not a stationary reference point, the starling must continually correct for the sun's movements across the sky to maintain a northerly orientation: it must keep the sun to its right during the morning hours and to its left during the afternoon. This necessitates that the birds know the time of day, a chore performed by their biological clocks (NATURAL HISTORY, March, 1966).

This time-compensated sun-compass orientation adequately explains much of the directional orientational ability of birds during daylight, but many species migrate at night. Observers scanning the night skies with telescopes have reported seeing thouands of birds in a short period of me. Eight o'clock to midnight and our to six in the morning seem to e the peak times for nocturnal flight.

Nocturnal migrants use the stars guide their flights. This was bril- antly shown by Franz Sauer, work- ng at the University of Freiberg, ho found that warblers would as- ume the proper migratory headings cages under the night sky, or even a planetarium. By orienting to ar patterns, these birds headed orth in the spring and south in the ll. They had been raised by hand the laboratory and had never seen e night sky before, showing that eir star-compass was innate.

Visual clues, sun-compass, and ar-compass orientation explain any of the navigational capabilities f birds, but major problems still re- ain unanswered. For instance, mi- rating birds sometimes fly through e densest fogs, staying on course in ite of the zero visibility. These irds are certainly not using celestial r terrestrial landmarks for guid- nce. Laboratory experiments have own that some migrating birds are apable of maintaining the proper igratory orientation in a closed oom with no view of the sky—sug- esting some sort of "sixth" sense. ut when placed in a steel-lined oom, the same birds lost their ability orient, which indicated that the orces responsible for migratory rientation may have been inter- epted by the metal shield. Man's henomenal success in exploiting the roperties of the compass in naviga- on compelled some investigators study the possible use of geomag- etism by orienting birds.

Skeptics were quick to point out hat there is no known receptor in rganisms that responds to magnetic elds. Since environmental stimuli such as light and sound) are all ensed by specific receptors (the eyes, ars, etc.), one might conclude that magnetoreceptor would be neces- ary. The criticism is slightly prema- ure, however, for this obstacle need ot be faced until it is learned hether or not an animal is suscep- ible to magnetism. In passing, it ight be interesting to point out that agnetic fields can be "seen" by man. If a man is placed in complete darkness in a rapidly alternating magnetic field, a luminous glow called a phosphene is recorded by the retina of the eye.

Because of its several unique properties, the geomagnetic field could provide birds possessing a "living compass" with all the information necessary to find a particular goal. Geomagnetic lines of force emerge not only from the North and South Poles but also from most of the surface of the Northern and Southern Hemispheres. In addition to the relatively constant north–south orientation of these geomagnetic lines of force, a second important property is the differences in the angle of inclination of the field emanating from the surface of the earth. Actually the earth's magnetic field is parallel to the ground only over the magnetic equator, an imaginary line roughly parallel to the geographical Equator. At the magnetic north and south poles the magnetic lines of force are vertical. As one travels from the poles to the equator the field gradually changes from vertical to horizontal. This change can be demonstrated by mounting a balanced compass needle on a horizontal axis so that it is free to turn on a vertical plane in response to the angle of inclination. This angle differs over the face of the continent; for instance, it is 50 degrees in Florida and 75 degrees in New York. These properties stimulated biologists to postulate that the birds might use the horizontal (directional) vector of the magnetic field in choosing the general direction of their migratory flights, and search out the proper angle of inclination of the vertical vector to locate a particular geographic region in which to land.

While early experiments failed to show any role of terrestrial magnetism in bird orientation, in 1947 a line of positive evidence was developed by Dr. Henry Yeagley, a physicist at Pennsylvania State University. Using homing pigeons Yeagley attached tiny bar magnets to the wings of half his birds and sham magnets to the remainder, and released them as much as 100 miles from their home loft. The minute magnets, moving rapidly up and down during flight, caused unnatural oscillating magnetic (and electric) fields to pass through the test birds. At the conclusion of the experiment a greater number of the birds provided with sham magnets returned to the loft than magnet-bearing birds—suggesting that the orientation of the latter was disrupted by the presence of the magnets.

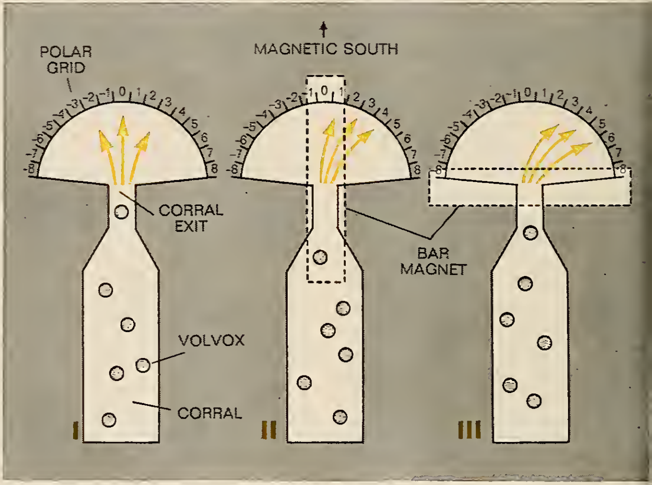
The scientific world in general, and ornithologists in particular, were quite excited by these findings, and several investigators immediately attempted to match them. Unfortunately, these men (and Yeagley also in a later experiment) were unable to reproduce the original results.

Animal psychologists, using the classic methodology of their discipline, have also attempted to study the effect of magnetism on living organisms. In 1954, Drs. Arthur Orgel and James Smith, then working at Florida State University, subjected homing pigeons to mild electric shocks periodically transmitted through a metal grid on the floor of their cage. In the first experiment a warning light was flashed on seconds before the current was allowed to surge through the cage. If the birds happened to be running in the cage when the light was switched on, the experimentalists did not follow with the shock. After many repetitions the birds made the association between the warning light, running, and the avoidance of the painful shock. When the birds reached near perfection in avoiding the shock, a new warning stimulus—the sound of an electric buzzer—was substituted for the flashing light. The pigeons quickly learned the meaning of this warning also. In the culminating experiment the warning signal was again changed, now to a 5 gauss magnetic field (about 25 times the strength of the earth's magnetic field) created by switching on an electromagnet adjacent to the cage. In spite of a more extensive training period the birds did not learn to avoid the electric shock, indicating that they were never able to sense the presence of the magnetic field. While this experiment does not duplicate any conditions that exist in nature, it does seem to indicate that birds do not have the capacity to respond to magnetic fields.

Because of the plethora of inquisitive ornithologists and lay bird enthusiasts, essentially all of the early work on the magnetic-compass basis of animal navigation focused on bird orientation. Birds display many complex behavioral patterns, and it would be expected that separating responses to magnetism from the myriad of other responses they display might be quite difficult. Possibly the experimentalist should turn his attention instead to a "lower," less complex animal in hope of separating an orientational response to magnetism from the rest of the animal's overt behavior.

A breakthrough in these attempts came in the summer of 1960 when a group of zoologists under the leadership of Dr. Frank Brown, then working at the Marine Biological Laboratory on Cape Cod, were able to demonstrate a real influence of weak magnetic fields on the directional orientation of an organism. As an experimental subject, these investigators chose the slow-moving mud snail. Through a set of ingeniously devised experiments they were able to show that this sluggish animal could actually distinguish between different magnetic intensities and was also aware of the direction at which magnetic lines of force passed through its body. This discovery should have marked the beginning of a major revolution in the field of animal orientation: at the time, however, the scientific community was geared to discovering only how animals *known* to navigate (specifically birds) might use magnetic fields. Therefore, this brilliant discovery received only mild enthusiasm.

Using a technique essentially similar to Brown's, I undertook the job of extending this type of study to another organism. An ideal experimental subject should be relatively simple in body organization, large enough for ease in handling and observation, and small enough to maintain in large numbers in the laboratory. We therefore chose an aquatic alga called *Volvox*, a direct descendant of one of the first forms of life to inhabit the earth. At maturity, it is just visible to the naked eye and is constructed of approximately 50,000 gelatinous-sheathed cells arranged into a hollow sphere filled with diffluent mucilage. Each cell bears two flagella, a single red eye, and enough chlorophyll to undergo photosynthesis. Every cell acts as a tiny oarsman, with its flagella beating in exact synchrony with its neighboring cells. The name comes from the latin *volvere* (to roll), which is appropriately descriptive, for *Volvox* rotates on an invisible anteroposterior axis, always leading with the same end forward. This organism reproduces by forming daughter colonies within its womblike interior, a feat that has caused several natural philosophers to point out that this lowly organism is the simplest one in existence that undergoes pregnancy.



In the author's experiment, the paths of Volvox *(arrows) emerging from an enclosure changed significantly in response to the presence and orientation of a magnetic field created by a nearby magnet (dashed lines).*

The design of our experiment was exceedingly simple: A tiny corral, just large enough to restrain about 100 *Volvox*, was constructed with a single exit (*see drawing, above*). The exit was directed toward the magnetic south pole; the *Volvox* were allowed to escape one at a time and their initial choice of direction was observed. To measure their deviation from a due southerly course, a polar grid numbered between —8 and +8 was inscribed on the bottom of the water-filled container just outside the exit. As each *Volvox* crossed the outer perimeter of the polar grid, the sector it passed through was recorded by an observer watching the escape through a microscope. After severa thousand *Volvox* were permitted to emerge during repeated experiments and an average path was calculated and found to be approximately due south

To study the role of the earth's magnetic field, the next logical step would be to screen out this force and compare the paths taken by the *Volvox* in this condition with the results obtained in the earth's natural field However, while it is possible to reduce greatly the earth's magnetostatic field with rather sophisticated equipment, a practical biologist must resort to another method. We therefore slightly augmented the natura magnetic field surrounding the corral by placing a bar magnet near it The magnet was placed either parallel to the earth's field at a distance so that it produced a magnetic field of 5 gauss or at right angles to the earth's field. Equal numbers of *Volvox* were allowed to escape in each of these conditions.

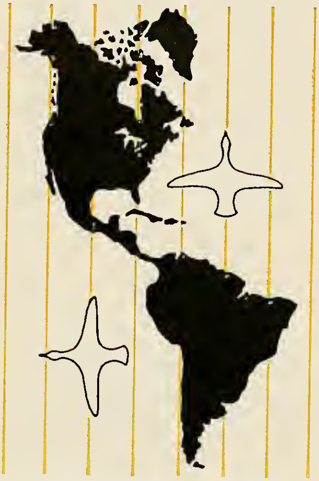
Any statistically significant differences among the average paths taken in each condition could be attributed to the presence, absence, or orientation of the magnetic field, since these were the only variables among the three experimental conditions. When the experiment was completed, it was found that the imposed magnetic fields did influence the initial orientation of the *Volvox*. Those in the 5-gauss field in condition II turned significantly to the right of those in condition I, and those in condition III turned twice as far to the right as those in condition II. Therefore, in some as yet unknown way, these tiny motile algae altered their initial orientation in the experimental magnetic fields. The response is certainly a behavioral one and not a physical attraction or repulsion of the alga by the magnetic field.

For *Volvox* or for any other organsm to use the geomagnetic field in lirectional orientation it must be ıware of the angle of the horizontal ector of the geomagnetic field passng through its body. For example, ı bird flying in a northerly direction vould have to keep the geomagnetic ines of force passing through the ong axis of its body, rather than at ight angles to this axis.

Because of the design of the exeriment it is possible to conclude hat *Volvox* (and possibly other rganisms) *does* have the capacity to se a magnetic field for directional rientation. The difference in averge paths taken by *Volvox* in condions II and III (in magnetic fields f essentially identical intensities riented at right angles to each ther) indicates that *Volvox* can ısily distinguish between the two.

Whether or not the geomagnetic eld is actually used to guide the vimming activity of these organms is not known, but certainly the ıpacity to use the field is present. hat *Volvox* can use magnetic fields ı spatial orientation may indicate ıat the ability to respond to magetic fields was instilled in organisms oon after their inception on earth, nd if useful for survival, that this ıpacity may have been passed on to gher organisms—such as birds.

Further information about the responses of organisms to the geomagnetic field was obtained in 1962 at Dr. Frank Brown's laboratory at Northwestern University. In an apparatus similar to that described for *Volvox*, he tested the common flatworm, *Planaria*, in the geomagnetic field, without the addition of magnets. He first observed a series of worms crawling due north, then rotated his entire apparatus 90 degrees at a time so that it first faced west, then south, and finally east; he then observed the emergence of an equal number of worms in each of the major compass directions. When the worms' initial orientation was north or south, they veered—on the average—to the right of straight ahead, and when the apparatus was directed east or west, they turned counterclockwise from an initial straight path. These differences in orientations clearly indicated that the worms were aware of whether the geomagnetic lines of force were passing through their bodies parallel or at right angles to their long axes.



The angle at which magnetic lines of force pass through a bird's body may aid in determining flight direction.

To measure the precision of the planarian's ability to distinguish among different angular orientations of magnetic fields, Brown performed the following experiment. He directed his entire apparatus to the north and rotated a bar magnet beneath the apparatus, 15 degrees at a time, between north and west. An equal number of flatworms were allowed to crawl over each of the magnet placements and their average paths compared. Other worms (the controls) were measured in the earth's field only. As the orientation of the magnetic field was altered from north to west, the planarians turned progressively more counterclockwise at each new setting, showing that they had the ability to resolve angular differences as small as 15 degrees.

In the last few years a great deal of work has been done on the initial orientation of several organisms in magnetic fields. In addition to snails, *Volvox*, and planarians, similar magnetic responses have been demonstrated in the protozoan *Paramecium*, the fruit fly, and a European beetle. In fact, every animal tested—using this type of experimental design—has been shown to alter its initial orientation in experimental magnetic fields, suggesting that this type of response might be common to most animals. Unfortunately, no further work has been done on the role of magnetic fields in bird orientation. The loss of orientation ability of birds in a steel room, but not in a wooden room, suggests that some environmental force—possibly the geomagnetic field—plays a role in bird orientation. Recently two Russian biologists, Drs. El 'Darov and Kholodov, of the Academy of Science in Moscow, have compared the amount of spontaneous activity in five species of captive perching birds both in, and in the absence of, a very weak magnetic field. In all cases the amount of activity increased—in some cases by more than 87 per cent—when the birds were subjected to the magnetic field. This discovery emphasizes the role that magnetic fields play in the lives of birds, but the exact nature of this role has not yet been resolved. It is quite possible that the proper experiment has not yet been designed to separate orientational responses to the geomagnetic field from other behavioral responses. Hopefully, a final answer will be forthcoming as a result of further experimentation.

TRIALS OF A ZEBRA HERD STALLION

by Richard D. Estes

Late afternoon, as the herds begin to return from pasture to spend the night on the short grass of the central plain, is the time for play and fights.

Great troops of the common plains zebra. *Equus burchelli,* are made up of little herds. There are bachelor herds and family, or harem, herds composed of females and young. Each family is owned by a single stallion, and the herds are semi-nomadic, although limited in range by their dependence on water. The exclusive, continuing ownership of a harem and nomadic habits are unusual among hoofed animals.

In probably the majority of them, adult males are attached to a piece of ground, and enjoy possession of females only as long as they remain inside the territory. This system is typical, for instance, of antelopes, the largest group of hoofed animals. Another system is represented by cattle (subfamily Bovinae): males are non-territorial and herds commonly include more than one bull, arranged in a definite hierarchy with one master bull dominating the rest. All sorts of variations on either theme may be found in the different subfamilies and tribes of ungulates, but it is hard to find another system exactly like the plains zebra's even within its own family, the Equidae.

Horses, asses, and zebras are so closely related that crosses have been made between nearly all eight species, and taxonomists lump them in one genus, *Equus.* Their displays and eneral behavior are very similar. et they seem to differ widely in so- ial organization. In free-ranging rue horses (*E. caballus*) it seems at stallions own both a harem and territory. This was the conclusion f Robert Schloeth, who studied the mous semiferal horses of the amargue, in southern France; and red Bruemmer, writing of Sable sland "wild" horses and Dartmoor onies in a recent NATURAL HISTORY rticle (August-September, 1967), entions that "Each herd has its own, nall territory and rarely roams rther than a mile or two." Accord- g to John King, even the Grévy bra, *E. grevyi*, the rarer, larger, and ore finely striped species from orthern Kenya, Ethiopia, and So- alia, is territorial. He found the iggest stallions alone on large terri- ries up to a mile in diameter. But e also found mixed herds containing ore than one adult male.

Perhaps wild-ass society comes earer the plains zebra's system than s presumed closer relation. A. J. annikoff describes the onager, *E. emionus*, of Mongolia living in rge, mobile troops of 300 to 600, mposed of small family herds, each d by a stallion. On the other hand, erds of the Nubian wild ass, *E. sinus*, are said by F. Bourlière to be d by females, and to be joined by males only in the breeding season.

Just how much of this variability is real, and how much is fancied, is hard to say. Unfortunately very little attention has been paid to equid social behavior in the past, and now only the plains zebra is still found in anything approaching its former abundance. The systematic study of its behavior in the wild was first undertaken a few years ago, in Serengeti National Park and Ngorongoro Crater, Tanzania, by Dr. and Mrs. Hans Klingel of Braunschweig University. It seems likely that the great herds of wild (actually feral) horses that once roamed our western plains lived much the way common zebras of the African plains live today. But probably we shall never know.

Working mainly with Ngorongoro's largely resident population of about 5,000 zebras, the Klingels immobilized a total of 124 animals, mostly herd stallions; for individual identification they branded, eartagged them, and clipped their manes and tails. By photographing the other members of a marked animal's herd (each zebra has a unique stripe pattern), the Klingels were able to keep track of about 500 animals and to gain great insight into their social structure and population dynamics.

They found that a family, or harem, contained from one to six mares and their offspring, up to a maximum of about fifteen animals, and that herds were remarkably stable in composition. Only nine females disappeared from the known families in a period of two and a half years, of which two turned up in other herds (others probably fell prey to lions or hyenas). During the same period, only five of the marked herd stallions lost their harems. In each case the entire herd was taken over by another stallion—the herd itself remained intact. As a rule only the young become separated, males when they are one to three years of age, fillies often when they first come into heat as yearlings or two-year-olds. Although breeding continues year-round, 85 per cent of the births occurred from October to April.

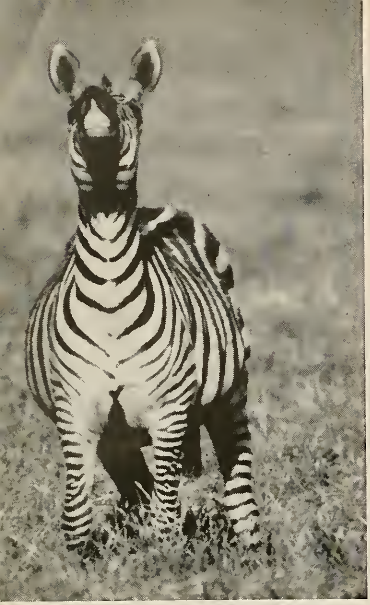
Given an approximately equal natal sex ratio, the harem system results in a large surplus of males. These may stay single but, like most gregarious ungulates, usually form bachelor herds. Competition for females is so fierce that bachelors are not ready to become harem masters until they are at least five to six years old, even though they reach puberty about as early as females. It is easiest to start a harem by abducting a filly; otherwise it is necessary to fight a winner-take-all battle with the herd stallion, which, as indicated by the Klingels' data and the fight pictured here, is the hard way to go about it.

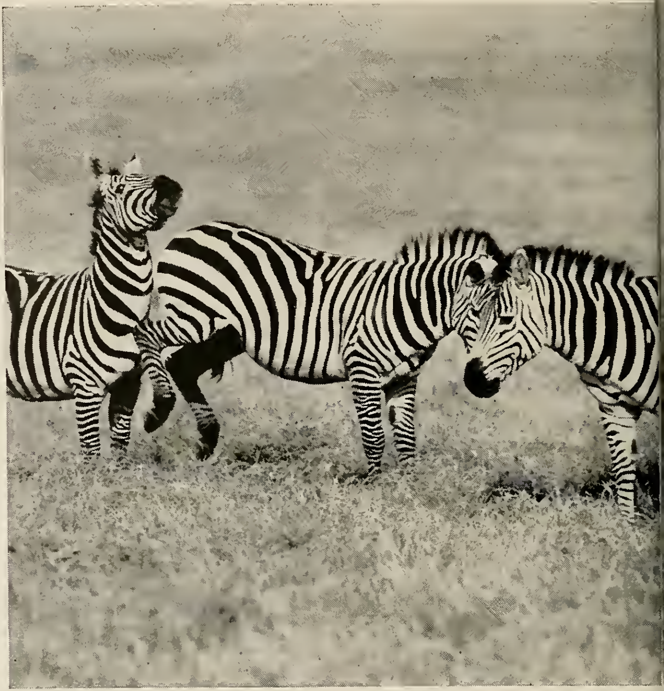
The herd stallion in this case happened to be one the Klingels had marked. He was branded with the letter *S* on the right ham, had a yellow tag in the right ear, and in addition, his mane and tail had been shorn, giving him somewhat the look of a small (600-pound) polo pony.

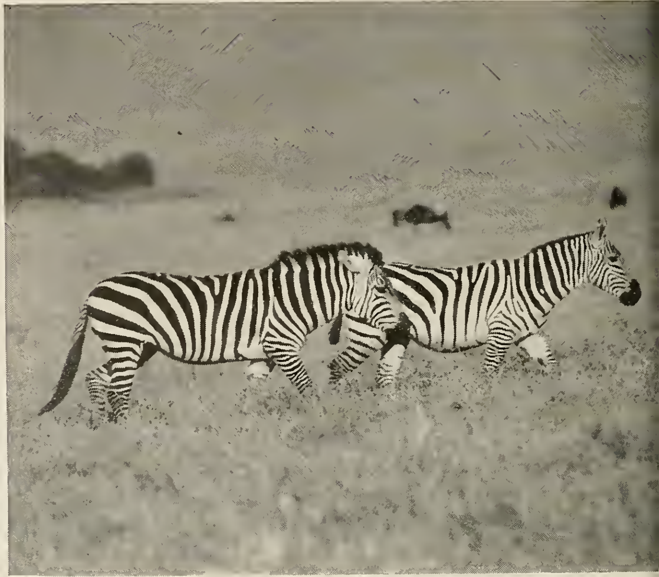
Shortly before five one July afternoon, I drove near a big concentration of wildebeest (the species I was studying) and zebra, to watch them move out from the marshland greenbelt, where they had grazed all day, to the central plain, where they would spend the night on short grass. Game is most active, and one is most likely to see fights and play, in the last hour or two of daylight; in fact I had photographed a zebra fight here just the day before, and now, no sooner did I arrive than I spotted another one, involving *S*. There were at least four stallions following his herd, attracted by one mare who was in heat. To judge from the mud and bloodstains on *S* and the other stallions, fighting had been going on among them for a whole day, possibly longer. The bout I filmed covered several miles of ground, and was still in progress when darkness fell more than two hours later. It was so exciting, I nearly wrecked my Land Rover racing over boulder-strewn fields rather than miss any of the action.

The zebra stallion's willingness to take on all comers in defense of his harem is a most impressive display of determination and stamina. If every rival he faced was starting out completely fresh, probably it would call for more endurance than flesh and blood could provide. Fortunately for him, though, the rivals also fight with one another. But this is not enough to explain why the herd stallion almost always wins. His winning simply illustrates the principle that right makes might.

Sexual Arousal and the Challenge of a







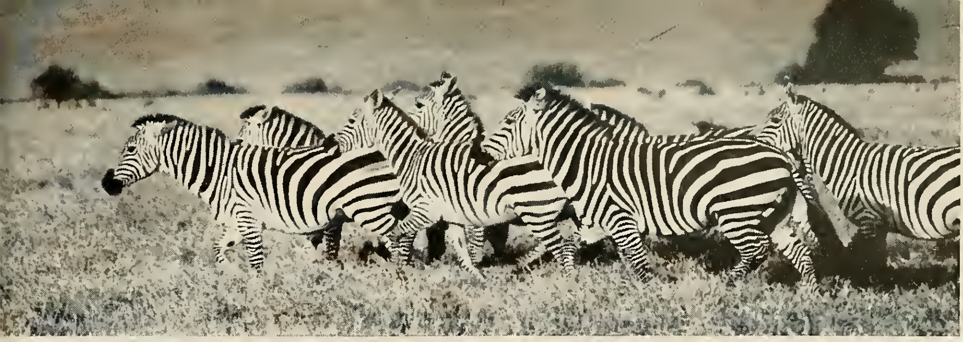
A stallion, above, performs Flehmen. *Called "testing" by horse breeders, it is related to an olfactory urinalysis whereby males of most hoofed animals determine the reproductive status of females. Males test the urine of every female but are stimulated sexually only by the scent of one near estrus. At a place where a female in heat has urinated, three excited stallions, above, center, jostle and kick. Above, right, the owner of the interesting female, a stallion branded with an* S *on his right ham, demonstrates ownership by repeatedly defecating with tail held stiffly erect. Such scent marking, now perhaps mainly a visual threat display, suggests that the plains zebra, like some other equids, once defended fixed rather than movable property. Confronted by a persistent and aggressive stallion (note flattened ears), right,* S *patrols in step with him, guarding his harem. The interloper dashes past* S *toward the harem. As* S *overtakes him, center, right, the challenger unleashes a mighty kick that barely misses. They circle, at far right, neck wrestling and trying for a grip with their long, wicked incisors.*

erloper

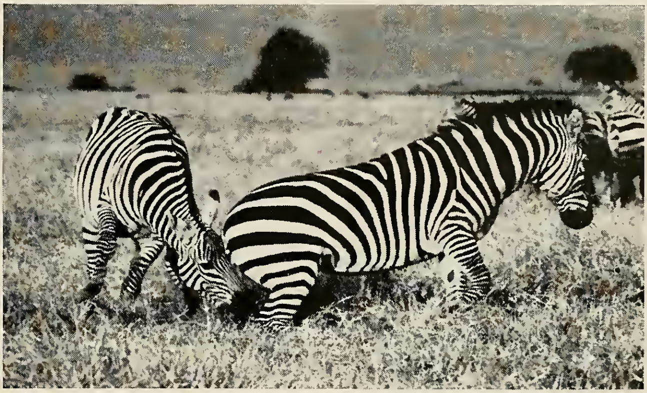
The Fight Is Joined and Intensified as Mares Watch

The combatants clash on the crest of a hill, left, as a territorial gnu bull looks on. S hangs on his rival's neck as he tries, unsuccessfully, to bring him down. Neck wrestling again, at bottom left, both animals are lumsy with exhaustion, their mouths agape as much to pant as to bite. The challenger grabs at S's hind leg, below, center; to counter, S drops to the ground. They both circle on their knees, each trying for a grip on the other's hock. far right below, as S tries to stand, the other presses against him, but S manages nevertheless to struggle free and rise. S's mares, at right, are absorbed spectators. The harem followed wherever the stallions went, keeping them always in sight.

Defeat, Resurgence, a a Third Pa Intercedes



ter more circling, the challenger ecures a grip on S's hock, top left. S rolls on his side, left, and lies s his rival grinds away. The only und is quick, stentorian panting. leasing S, the challenger runs back kes over the harem. But S gets up and runs after him, limping only slightly. Above, S comes up (far right) and cuts between his right foreground) and the harem. In turnabout, right, S tries for same hock grip. Below, S (on left) gains respite as another stallion engages the first rival. Resighted month later, S still had his herd, having stood off all challengers.



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Reviews

Continued from page 29

world, I can say that his astronomy is reasonably accurate. Of course, in a small book the treatment must be superficial, allowing little chance for major misstatement. If a youngster of ten or twelve seems ready to graduate from fairy stories, this book may be an excellent means of making the transition.

The First Book of the Moon, by Carroll V. Glines (Watts, $2.65), is more substantial than Mr. Slote's work, but this makes error more probable, unless the author is an expert. Apparently he is not, because several mistakes of varying degree can be reported. Some are editorial in nature: "Not only is an eclipse of the moon seen more frequently on earth but it can be also viewed from more points on earth than can a solar eclipse." This sentence would convey information if it were rewritten: "An eclipse of the moon is seen more frequently because it can be viewed from more points on earth than can a solar eclipse." Other errors result from the faulty use of words that frequently occur in science exposition: "It has been estimated that the density of the moon is about 3⅓ times that of water." In science, an *estimate* of an otherwise unknown quantity is nearly a guess. Unlike the random nature of a guess, however, an estimate is a value between upper and lower limits that have been set by careful analysis of the many facets of the problem. Fortunately, it is not necessary to estimate the mean density of the moon because its mass and volume are known with sufficient accuracy to allow the value of the moon's density to be *determined*.

Another example of a poor choice of words: "a year was decided upon which would be 365¼ days in length." Here, "decided upon" makes the year appear to be an arbitrary number of days. And scientifically, it is doubtful that the Babylonians, about whom the author is writing at this point, knew about the one-quarter day.

Then there are some errors of fact: "Meteorites which strike the earth seem low in iron content," and "scientists know [lunar craters] are, without exception, circular." (One of the crater puzzles is why so many of them are polygonal.) And for a picture correctly identified as being an annular eclipse, the caption further describes the same picture as a lunar eclipse.

None of these and other errors are important to a reader who doesn't need the book. It can also be argued that the beginner is likely to retain only a small fraction of the material contained in it, and the chance that one of the errors will be learned as a fact is small. This is no reason, however, for not having the book cleaned up by a knowledgeable scientist for the next edition. The pity is that it was not done before publication because the book otherwise has considerable merit

Passing beyond the moon, we fin *Exploring Other Planets*, by Patrick Moore and Henry Brinton (Hawthorn $3.50). This is a 1967 American edition of a 1965 British publication. I is a quick run-through of the sola system with mention of some of the findings of space probes and radi astronomy and of the possibility of a few projects for science fairs. It i curious that the 1967 printing was no used as an occasion to update information about the rotations of Mercury and Venus. Indeed, radar observatio shows that Mercury rotates in 58 instead of 88 days, requiring a complete different description of conditions o that planet. No longer is one sid eternally dark and frigid as stated i all earlier accounts.

An artificial mystery is created o Venus when we read: "The result were in complete disagreement wit those of Mariner II. It was found tha the clouds of Venus were probabl made up of ice crystals. If so, then th surface temperature may not be nearl as high as Mariner showed." The ic crystals are in the highest levels in th atmosphere and bring us no information on surface conditions. Marine II, on the other hand, did not negat ice crystals in the upper atmosphere.

I get the impression that this boo was "cranked out." There are other an better books about the planets. Thi one does not have enough recent information to make it necessary in one' collection, but if you have no other, i will not cause much damage.

K. L. Frankli

Botany and Ecology

Several years ago, *The New Yor Times Book Review* had an article deploring the low state of science writing The author noted that psychologist were the only group who have manage to capture the interest of the genera reader. At the time, we were rather indignant and, in reply, wrote that sinc people are basically interested in themselves, the psychologists had a built-i audience. We appended a list of recognized scientists who have writte splendid books and indicated tha there were probably many other scientists who could have been added to th list. As judged by the current sma crop of books in botany and ecolog for younger readers, it is possible tha we may have to eat our words.

Before proceeding to the books t

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be reviewed, it might be useful to note the criteria used to evaluate them. Although professional scientists should put accuracy first, there is little need to stress this point. At the level of a child's book, there is no excuse for sloppy handling of the facts. We believe that the primary requisite for a child's book in any science is eye appeal. Children respond quickly to really good pictures, drawings, diagrams, and type. Most of the books under consideration have, at best, pedestrian illustrations, detracting greatly from their capacity to excite the interest of the reader.

To our surprise, good, clear, straightforward writing is the exception. Children aren't looking for clever writing—indeed, in a science book, the child is thrown off stride by wordplay. Antecedents must be precise, sentences should be declarative, and exclamation points should be scrupulously avoided! The "isn't nature wonderful" concept can send a perceptive child to pornography before he is old enough to appreciate it.

Pedagogues may argue that facts tend to get in the way of imagination and that a book should set a child to dreaming. We, on the other hand, believe in facts, lots and lots of facts. Illustrations should amplify facts; chapters should be arranged to present facts in a sequence that makes sense to the reader. Facts can expand horizons, generate excitement, and send the reader away bursting for more.

Two of the books published this past year should have fulfilled these criteria. Michael Gabb and Michael Chinery coauthored *The World of Plants*, a volume in the English "Foundations of Science" series (Ginn, $5.25). Jean Vallin is the author of *The Plant World*, the second volume in a series called "Basic Biology" (Sterling, $3.95). The contrast between the two books is striking. Gabb and Chinery's book is organized into logical sections dealing sequentially with how plants live (physiology), the structure of plants, reproduction, classification, and non-flowering plants—with codas on bacteria and on unusual ways of plant life. The writing is dull, but accurate; the book is profusely illustrated with some of the worst drawings we have seen, in the most garish colors imaginable. It is too technical in some places and skimpy in others. While Vallin's book is arranged rather haphazardly in terms of logical development of the topics, the writing is sprightly, the facts are simply presented, extensive, and accurate. The photographs and the colored line drawings are delightful. If the child can be induced to first read Vallin and then Gabb and Chinery, he will have a firm plant science foundatio But, don't let him read the books reverse order.

Margaret Cosgrove's *Plants in Ti* (Dodd, Mead, $3.25) is a difficult bo to categorize in terms of reader au ence. The text is too simple for 1 year-olds, but the material is too d ficult for 9- to 11-year-old childre The author is addicted to the use quotation marks and gets a mite cu at times. The illustrations are general poor and of limited utility. The bo just doesn't jell, probably because the age—text discontinuity. Neverth less, it has sufficient factual material warrant a mild recommendation.

A Tree Called Moses, by Laura N son Baker (Atheneum, $3.50), is adventure story with a sequoia as hero. This fictional 2,500-year-old tr had a rigorous and harrowing life, b still stands in spite of the vicissitude from fire to man, that a tree is heir The drawings are plentiful, accura and illustrate the trends of the sto line. It is a great story for an 8-year-o

Plants without Leaves, by Ross Hutchins (Dodd, Mead, $3.50), shou have considerable appeal for the old child who already has an interest plant science. The author has writt in a clear, chatty style and has ill trated the book with beautiful pho graphs of many of the plants discuss in the text. Taxonomic categories a only rarely mentioned; rather, t book successfully presents a wealth factual material about those primiti plants that lack true leaves. The e phasis is on those that are useful harmful to man, or that have so special features. The chapter on t fungi is basically restricted to t higher fungi—those that the child most likely to have seen. There is short chapter on the slime molds a three chapters on lichens. This e phasis on lichens, the symbiotic ass ciation between algae and fungi, is o of the charming portions of the boo Hutchins writes about the ecologic range of these plants and their ec nomic value. The final chapters inclu a discussion of the two groups of t bryophytes—liverworts and mosse and the horsetails. There is a bri bibliography and an index. The auth has taken all but two of the phot graphs used; he is to be commend for them. Although the text is simp written, these photographs alone m make the book of interest to adults.

RICHARD M. KLEIN, DEANA T. KLE

Earth Sciences

It is interesting to glance at t titles of the books reviewed for youn sters each year and speculate abo ir relationship to the fields receiv- the most publicity. Last year, eight of the sixteen books that I reviewed ited to water and water pollution. s year, of the ten books that were red, three are on this same subject. a sense, this is encouraging because nay reflect a continuing concern h our water problems. Four of new books are in the general area oceanography, and again this re- ts growing interest in the activity of s newer and more rigorous field. o books of a geographic nature and biography complete the list.

'he best of the three books about er and related problems is *Our luted World*, by John Perry (Watts,)5). This was the most readable of group because it is calmly and oothly written and includes the per- al experiences of a writer who roughly knows his subject. Perry great objectivity and does not in- ge in the diatribes that pollution blems frequently generate. His ements on how people are going ut solving the problems are partic- rly well presented, giving alterna- s and a knowledgeable account of economic and social aspects. His c into the future, while chilling, at st prepares us for what is to come.

ll-in-all this is a first-rate and highly ommended book about a subject that s not lend itself well to organization.

'he *Water Crisis*, by D. S. Halacy, (Dutton, $4.95), is a scholarly and urate essay on water. The author iously did much careful research, the resultant book is factual and l presented. All books on this sub- cover much the same material and almost identical examples. I sus- t that this may be the result of ilar source information and a limi- on of the subject itself. This book ows a familiar format, discussing increased use of water, which en- ders an increased number of pol- on problems. The introduction is owed by a very good chapter on peculiar properties of water and these work for and against man. ns and their problems, water con- ation, and desalinization follow. concluding chapters are concerned n the future, and here he discusses sual sources of water. The book ers from too many boring statistics repetitive statements and exam- s, but it is, nonetheless, a good refer- e book for the school library.

he last book on water, *Rivers*, by Villiam Harrison (Messner, $3.95), a sharp contrast to the other two. It ell conceived and well illustrated, there are many errors of fact, ex- erations, and misconceptions that

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mar the effort and cause me to place the book on the not-recommended list. Mr. Harrison is an accomplished and gifted writer, and my criticism is aimed at some of the more scientific and technical aspects of his discourse. Perhaps the blame should be laid at the publisher's door, for had he sent the manuscript to qualified reviewers, particularly in the fields of geography, geology, and biology, the results might have been better. Finally, the editor did a rather poor job of rooting out inconsistencies, and repetitive statements.

Two books, *The Ocean Adventure,* by Gardner Soule (Appleton-Century, $5.95), and *Science Beneath the Sea,* by William M. Stephens (Putnam, $3.29), are entirely devoted to oceanography, or to use Soule's term, oceanology. Oceanology is a combined effort of science and engineering to tackle problems of the study and use of the sea. I am certain these books are harbingers of a flood to come. As with books written on the same subject, both cover much the same ground and use the same examples and illustrations, such as the deep-sea "monsters," new types of submarines, man's life under the sea, the *Thresher* disaster investigation, the U.S. Navy submarine triumphs under Arctic ice, and Mohole.

Science Beneath the Sea is designed for the younger faction of our age group. Mr. Stephens, who is connected with the Institute of Marine Science, University of Miami, is not a scientist. The book, I think, suffers in consequence. There are absurd statements, unwarranted conclusions, and storytelling. For example, he says, referring to Lower Paleozoic seas, "At about the same time [as the extinction of the trilobites] carnivorous fishes and octopuslike creatures (ammonites) came into being, and life began moving ashore." First of all, the trilobites lived 200,000,000 years longer than he indicates. Furthermore, his inference that the time the shallow water forms came into being is Silurian is incorrect. Actually shallow water forms lived near shore back in the Precambrian.

On the whole, the book is well organized and has excellent photographs and diagrams. I am not sure why authors of children's books feel compelled to present facts in a way that may be misleading. In the chapter "Mining and Farming the Sea," Mr. Stephens says that animals concentrate trace elements—snails, for example, will concentrate iron in their radulae. The implication is that some day we will be able to recover iron from this source. What he does not say is that snail radulae are extremely rare and disbursed sporadically throughout the ocean sediment, and that only a few species have such concentrations. Thus, it is obvious

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at the economics of recovery would ohibit any possible use of this ource." I cannot place this book very gh on the list.

Mr. Soule's *The Ocean Adventure* is bargain either in terms of good ju-nile-oriented writing. I found that e author has taken fascinating topics d converted them into dull reading. e main problem is his method of cumentation. He includes in the body the text endless lists of things, such who made submarines, their prices d specifications. It would have been tter to place them in the appendix. e uses much space in the early part the book for eyewitness quotes, any of which could have been para-rased by him or, better yet, not used all. Mr. Soule indulges in the same rt of misleading statements that Mr. ephens did in discussing mining of e sea. He says that the abyss (6,000 et deep or more) is covered by lime ed in cement making, the implica-n being that here we have a treasure ve for future cement. He does not y that vast quantities of lime exist very shallow, untapped waters all er the world, which would be infi-tely cheaper to recover.

The best chapters, in my opinion, late the undersea adventures of the bmarines *Nautilis* and *Skate*. They e well written and suspenseful, but en here they would have been better d the author told the story rather an used long quotes from the partic-ants. The best part of the book is full bibliography.

If you are compelled to buy a book the field of oceanography, try to wait something better, but in the mean-e the Stephens book is one notch up m *The Ocean Adventure*.

Islands of the Deep Sea, by Albert B. rr and Robert S. Hopkins (John y, $2.96), is recommended by the blisher for young people in the 12 15 age bracket. I would place the es at 11 to 13. I have included the iew because the book is unique in vering islands of the open ocean. The lume is an interesting potpourri topics related to coral atolls. Chap-s deal with the origin and discovery atolls, how plants and animals came populate them, man's life and hard es on them, and something about archeology of the islands. The book not strictly about coral atolls since discusses Easter Island. On the ole, because it is a small volume, the atment of the subject is somewhat erficial. It seems a pity that the au-rs did not feel impelled to give more ails of Darwin's theory of atoll for-tion and some of the fascinating al-nate hypotheses.

In spite of the usual minor inaccuracies and the absence of a bibliography, I recommend it for the adventure-oriented reader.

Waves, Tides, and Currents, by Elizabeth Clemons (Knopf. $3.75), is obviously pitched for the younger set, 10 to 12 years of age. However. I have reviewed the book because it is exceptionally well done. Elizabeth Clemons has thoughtfully put together this book starting off with a general discussion on the character of the tide. She deals very adequately with waves, their origin and character, the damage from tidal waves and tsunamis, and finally with the nature of research on currents, tides, and waves and how they are being utilized to the advantage of man. Throughout the book she makes the reader aware of the tide's effects on the shore and the people living on it.

This is a well-written, logical, and accurate piece of writing—my favorite book of the set on the oceans.

Rock, Time, and Landforms, by Jerome Wyckoff (Harper & Row, $8.95), is a logically developed thesis based on explaining landforms as products of geologic processes and forces. In our new generation of frequent and extended traveling, this book will fill an important need—that of answering the question that perceptive travelers will ask regarding why that mountain (or stream or sea coast) is where it is and why it has that shape.

A concluding chapter develops the newer theories on the formation of continents, islands, and sea bottoms. This is not a book to curl up with but rather one to take on a trip (particularly if you live near eastern New York State, the source of many of the author's examples) or to use as a reference. The illustrations are excellent, but some are lacking scales, and in the text it would have been helpful to have a reference to an illustration when discussing an example. It also would have helped to have more alternate hypotheses; for example, the author states that there is a controversy about whether or not peneplains are real but fails to clearly state the opposing concepts. The editor has perpetrated an annoying problem, perhaps for the sake of lay-out design; it is irritating not to have numbers on each page, particularly if index references are cited. In general, a good book for the school reference library.

The Yosemite Story, by Harriet E. Huntington (Doubleday, $3.50), is a beautifully illustrated and interestingly written account of Yosemite Valley from its discovery to its creation as a national park. It is more than just a history of discovery, however, for the author discusses its creation, geography, and geology. As with the Wyckoff book, a copy of *The Yosemite*

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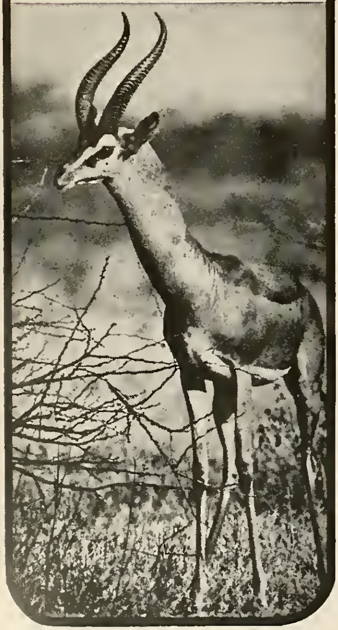

Story would be a nice addition to the kit of a traveler in the valley. The author does a good job of development but she obviously is out of her element in the more technical aspects of her story. As one example, she states "These sediments along with sand, mud, etc." failing to know that sand and mud *are* sediments. The best chapter in my opinion is on the glacial history of Yosemite. By and large a generally good book and recommended.

The final book being reviewed this year is *Charles Darwin*, written by Arthur S. Gregor (Dutton, $4.75). This is a well-executed and interesting book. It is impressive because it gives not only a fairly well-balanced picture of Darwin—man and boy—but more importantly, a clear, uncluttered statement of Darwin's scientific contributions. There is a fine essay dealing with *On the Origin of Species*, plus Darwin's follow-up books, including the *Descent of Man*. The final chapter brings the theory of natural selection up to date by introducing the genetic theory to account for inherited variation—the one gap in Darwin's original theory. This is followed by a good statement of Darwin in retrospect today, including the impact of the theory on social order and new direction. There is one weakness in the book, which is not Mr. Gregor's fault. The actual incubation of the theory following the voyage of the *Beagle* is not satisfactorily developed—it really can't be, for Darwin's autobiography itself (used as a chief source by the author) is vague. I highly recommend this book for the alert student.

ROGER L. BATTEN

Invertebrate Biology

The availability of serviceable, but inexpensive, Japanese microscopes must be largely responsible for the array of books on microscopy that have recently appeared for young people. Leeuwenhoek is certainly the man of the year, with one full-length biography devoted to him and descriptions of his discoveries in three other volumes.

Discoverer of the Unseen World, by Alma Smith Payne (World, $3.75), is a well-researched biography of Antoni van Leeuwenhoek, illustrated with lackluster drawings. Surely a clear illustration of one of Leeuwenhoek's microscopes or reproductions of some of his drawings would be more valuable than a sketch of his house. Extensive quotes from Leeuwenhoek's letters to The Royal Society form the most interesting part of this book and emphasize the amazing range and accuracy of this pioneer observer, who used only his

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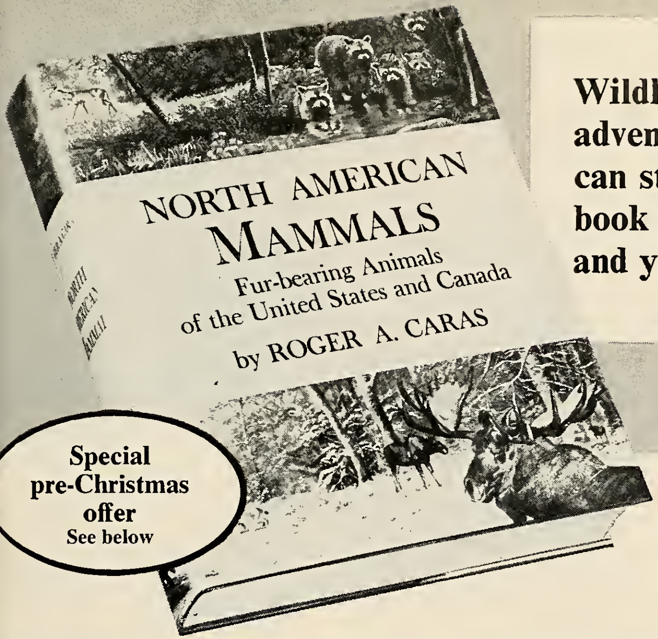

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own carefully constructed single-lens microscopes in his work.

Microbes in Your Life, by Leo Schneider (Harcourt, Brace & World, $3.75), is an informative, clearly written book about microscopic life dealing with algae, protozoans, fungi, bacteria, and viruses. The abundant illustrations truly complement the text. There are detailed drawings of many of the forms described, which would be useful for the beginning microscopist working on his own, and also diagrams illustrating techniques in bacteriology and virology. The book begins with a chapter that briefly outlines the history of the microscope and describes current instruments. (Here is a clear drawing of one of Leeuwenhoek's microscopes that was not to be found in the Payne volume.) This is followed by a short section on the chemistry of living things that is useful for an understanding of photosynthesis and cellular respiration, subjects presented later in the book. Even though this volume deals with somewhat sophisticated material, it is not beyond the scope of interested junior high school students and is highly recommended.

Window on the Unknown: A History of the Microscope, by Corinne Jacker (Scribner, $3.95), serves very well to introduce the somewhat older student to a serious study in the history of science. The format is not childish. Suggestions for further reading and footnoted references encourage additional study and help the beginning scholar get started on library research. There is a glossary of terms and a chronology giving the highlights of microscopic discovery that should be useful for quick references. The book is well indexed. Illustrations add to the text and are particularly useful in clarifying the discussion of optical principles. Miss Jacker makes good use of quotes from the original writings of many of the key figures in the history of microscopy, thereby adding to the interest and flavor of the text. However, the book is not without minor errors. For example, papillae are not necessarily taste buds of the tongue, although taste buds are examples of papillae; and the Chamber micromanipulator is no longer in use all over the world, but has largely been supplanted by more modern, easier-to-use instruments that operate on different principles. Nevertheless, this book is warmly recommended for the biologically sophisticated high school student.

Another book dealing with a similar subject is *Seeing Near and Seeing Far*, by L. J. Ludovici (Putnam, $3.49). I found this book not nearly so interesting as the Jacker volume although it does have the added feature of describing the development of the telescope.

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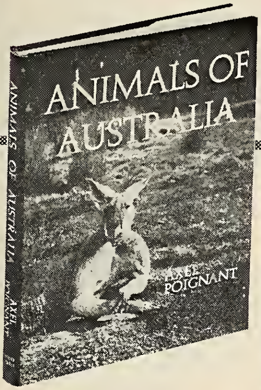

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The description of optic principles is unclear in many places, and the book is overly concerned with dates, not all of them accurate (or did Edward Culpepper live to the age of 127?). There is an index that is adequate for names and entirely inadequate for subjects, which it also professes to cover.

The Life of Animals Without Backbones, by Michael Gabb and Michael Chinery, is a volume in the "Foundations of Science Library" (Ginn. $5.25). This is a strange volume that seems to have been put together from a series of isolated articles. The result is a book where some subjects are repeated several times in different sections, while others are inadequately treated. For example, earthworm reproduction is described on page 51 and again on page 127. What good is it to say that the round mouth snail is not a pulmonate but is related to the winkles when winkles are nowhere described in the book? A "tree of life" that mainly features vertebrates has no place in this work. The only example of neoteny given is that of the vertebrate *Ambystoma*. Of three illustrations showing cell types, only one shows invertebrate cell types—the other two deal with human cells and plant cells. Despite these difficulties this book does impart considerable information about the anatomy, physiology, and life history of invertebrates. The organization is the main stumbling block. Besides, how can you call coral an "animal without any hard skeleton"?

L. H. Newman's *Man and Insects* (Natural History Press, $5.95) is a beautifully illustrated, information-packed volume that should have wide appeal to high school students and adults. Anatomy, physiology, and life history are dealt with in the beginning of the book, but the main portion of this volume is devoted to economic entomology. As the story unfolds, the reader is amazed at the many ways in which insects touch our lives. I found the chapters "Insects Carry Plant Diseases" and "Insects and Weed Control" particularly interesting. I was also unaware of the demand for artificially raised insects and found the section on insect breeding very informative. Surely there is something in this book to interest almost everybody and a great deal for the individual with a curiosity about insects.

MADELINE COOPER

Vertebrate Biology

Authors of children's science books have taken up the conservation cause. More than half the books I reviewed this year are concerned with animals

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whose populations have slipped to a dangerously low level; these animals are on the brink of extinction. It is particularly important to have books on conservation available to the young adults of today since they will have a profound influence on man's future environments. They must understand the problems and the choices: building a new dam and destroying a canyon. erecting new houses and demolishing a forest. constructing an airport and eliminating a game sanctuary. The choices are not easily made, nor are the problems easily solved. But before any plans toward conservation can be formed. it is essential to know about the affected animals—their requirements for living space and food sources, their life histories, reproductive rates, and population fluctuations. Certainly none of us wants to have only concrete highways. telephone poles. and artificial lights as substitutes for the redwood reaching skyward, the quail running across a field. or the osprey soaring effortlessly over a pond. The need for conservation is recognized by those who know that nature can exist without man. but that man cannot exist without nature.

One book. *A Vanishing Thunder*, by Adrien Stoutenburg (Natural History Press, $3.50). is after the fact—the animals have become extinct. It is a warning. an example of how a "let George do it" attitude can lead to the untimely end of a species. The book, beautifully written and highly readable. is truly a poetic inscription on the gravestones of a number of bird species. A sense of tragedy permeates the pages as the birds' lives are recounted: their habits. migrations. and interactions with. and destruction by. man, the predator. The author tends to overlook an important species eradicator, however, the occupancy by man of the territory where the birds lived.

This omission is not made by Roy Pinney in *Wildlife in Danger* (Duell, Sloan and Pearce, $3.50). although the writing style is pedestrian and the book appears to have been hastily organized. resulting in some sloppiness in the order of points. Throughout. Mr. Pinney emphasizes that. in addition to predation by man. the loss of a species is due to man-made changes in the environment and that pollution. use of insecticides. and other harmful practices are more deadly than any weapons. There is a long list of vertebrates whose populations are low. truly in danger of extinction. and a selected group including the manatees. bears. sea otters. and cranes are treated in detail. The theme of each description is the animal's former abundance and its present numerical impoverishment. Mr. Pinney applauds the protection

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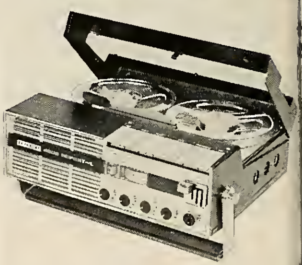

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that polar bears are now receiving from the Russian and Canadian governments, and he urges the creation of a world wildlife conservation program by the United Nations. The book is illustrated with ordinary photographs. It's too bad that it isn't more attractive looking and better written; its message is too important to be overlooked.

When I first picked up *Animals of the North*, by William O. Pruitt, Jr. (Harper & Row, $5.95), I assumed from its title that it would be a standard work on animals that live in or near the Arctic. Instead, to my delight, it turned out to be a fresh approach to the science of ecology, excellently written. The book compares favorably to an exciting novel. The author traces the life of several animal types (and a tree) by following the vicissitudes of an individual moose, lynx, hare, or caribou. One not only learns of their daily patterns but also, through the deft writing that intertwines these animals with other organisms, discovers where they fit into the intricacy of nature. Each organism is examined as part of the ecosystem. Mr. Pruitt deserves accolades for explaining behavior in terms of changing internal and external conditions rather than resorting to the easy way—calling it instinctive. Unfortunately, a few descriptions, such as how a lynx kills its prey and proceeds to eat it or how Indians butcher a moose, are gruesome, and some readers may be upset by the bloodiness. In counterpoint, one senses the lushness of these majestic regions and the author's deep pain when he sees the land torn apart as man seeks wealth from within the earth. The book's message comes clearly and sharply across: the demolition of one part of an ecosystem resonates to all other parts, and even though the animals are "conserved," the uprooting of trees and the destruction of meadows result in the untoward death of many. It is one of the most intelligent pleas for conservation that I have read.

Dorothy E. Shuttlesworth's *The Wildlife of South America* (Hastings House, $4.50), part of the "Hastings House World Wildlife Conservation Series," is divided into sections dealing with fossil types of South America, the early peoples, the scientific discoveries of Humboldt and Darwin, the fauna of the Galápagos Islands, and some living vertebrates. Essentially a survey, it sketches the remarkable variety of animals that live in the forests and plains of this vast continent. Both P. K. Crowe, who wrote the Foreword, and Mrs. Shuttlesworth stress the importance of education in bringing conservation about, and although the book is written primarily for North American readers they recognize that South

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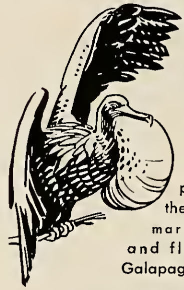

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merican children must also be edu- ted toward this goal. It is timely cause South Americans still have ousands of square miles of untouched nd and with careful planning can ll conserve much of their natural ritage. One can only hope that the ok's plea will not be ignored. There a bibliographic list on South Ameri- n animals and on conservation.

Bears are among those animals whose pulations are approaching the dan- rous point of no return—not only be- use of the hunter but because their cessary living space is being elimi- ted by population expansion. Phyllis teen's *Bears Around the World* oward-McCann, $3.49) is an excel- t book, with strong emphasis on the nservation of bears. The book is di- led into two parts: the first is a gen- l description of biology, evolution- y origin, appearance, size, range, rmancy, family organization, mother- b relations, etc. The second part has oldilocks touch as the author treats big bears, middle-sized bears, and le bears, identifying them species species, with pertinent geographic tails and specializations. Legends d folktales are interspersed with the tual details. The book is well or- nized, reads easily and clearly, has excellent index, a comprehensive ding list, and should serve as a good erence source. The photographs of fair quality.

The World of the Black Bear, by Joe n Wormer (Lippincott, $4.95), fits o the hackneyed-mediocre category. ually these "Living World" books built around excellent photo- phs. In this case the photographs only good, and they seem to have fered in reproduction, for they look t and fuzzy—was it done to resemble rs more closely? When Mr. Van rmer talks of his personal experi- es he's in good form; he gets into uble when he tries to explain be- vior. Following the standard pattern this series, the book is divided into four seasons, with discussion of biology of bears based on seasonal ivities. The author covers reproduc- n, development, feeding, etc. Obvi- ly several activities cover more than season, and this points up the awk- rdness of treating certain details der seasonal headings.

Black Duck Spring (Dutton, $4.95) ongs among the conservation- ented books. The author, Bruce S. ight, and the illustrator, James G. ason, have produced a captivating ry, written as if related by a black k. The duck traces its peregrina- s from Nova Scotia to Chesapeake y, telling of the hazards of being shot of not finding food, of its interac- s with other animals, and of rearing

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the ducklings. Although he has used a duck to tell the story, the author, who feels great compassion for these hapless birds, has carefully kept it from becoming humanistic. I think he will stimulate even the most indifferent person to think about conservation.

John Ripley Forbes has written an exciting biography, *In the Steps of the Great American Zoologist, William Temple Hornaday* (Evans, $3.25). Hornaday, whose life spanned the time when museums and zoos came of age, prepared for exhibition the many animals that he collected for museums and was also director of a zoo. An active conservationist, in the early 1900's he wrote of his fear that our wildlife was in extreme danger of extinction and predicted the death of many species. Unfortunately, his predictions are coming true. The book has a section on animal watching, identification, and how to set up a small zoo at home—many young readers will find this section extremely useful.

Africa is represented by two books, both very good. In *The African Elephant* (Golden Press, $2.95), Rennie Bere relates his personal experiences and observations while he was working in Uganda National Park. The writing is highly agreeable, and the factual information is adroitly handled. What might have been dry statistics in another book becomes fascinating and fresh knowledge in this one. The author describes relationships with other animals, sound production, use of elephants in warfare, and man's hunger for ivory tusks. Maps show distribution of elephants and the populations in different regions. While elephant births are not frequently witnessed, the author had the good fortune to be present at such an occasion and to see the participation of the non-pregnant cows. All in all, this is a well-written book, with a most attractive cover and splendid photographs skillfully placed in relation to the text.

In the same series is *The African Lion*, by Mervyn Cowie (Golden Press, $2.95). It, too, is a handsome book, similar in format to *The African Elephant*, and is based mainly on observations made in African national parks. The author puts the lion in perspective, not as the ferocious king of the beasts, but as a carnivore that, in order to survive, can only eat other animals. Initially, Mr. Cowie is ambivalent in his sympathies regarding the lion. The ambivalence may derive from fascination on the one hand, and fear on the other. Lions are troublesome and marauding pests—especially when they discover access to a domesticated cattle range. However, later he does make a plea for conservation and hopes that the book will help people to better

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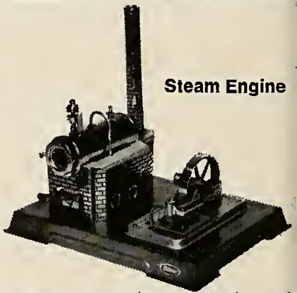

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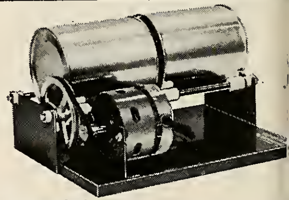

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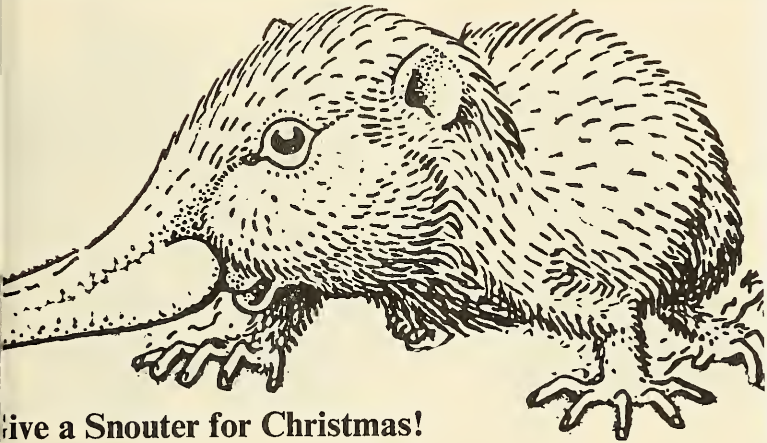

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understand and to respect this stately animal. It does. There is considerable detail about the daily life of the lion, the family organization, the interactions with other animals, the lion and witchcraft, and how lions may become man-eaters. It is unfortunate that here and there the story is marred by behavioral misinterpretations. Nonetheless, its positive contributions outweigh the errors—over-all, a spellbinding book with superior photographs. There is no index in this book or in *The African Elephant*.

Small Mammals Are Where You Find Them, by Helen Damrosch Tee-Van (Knopf, $3.50), is a short reference book on the small mammals one is likely to see near suburban or rural homes. The book is attractive, and a readily accessible source of thumbnail sketches of squirrels, woodchucks, bats, moles, chipmunks, mice, muskrats, skunks, and so on. With each species the author gives anatomical dimensions, a map of their range in the United States, food habits, habitats, sound production, locomotor behavior, reproduction, and number of young born. Her drawings show her sensitivity for animals and their facial expressions.

The World of the Woodchuck, by W. J. Schoonmaker (Lippincott, $4.95), is based on a not very impressive collection of photographs of woodchucks and other animals that live in the same ecological area as the woodchuck. The book begins in a somewhat disorganized way and the writing style is uninteresting. The interpretations of behavior are sometimes sophisticated, sometimes naïve. The story follows the "Living World" format and delves into the general biology of the woodchuck with the author's personal observations interspersed. There is a two and a half page bibliography and a mediocre index.

Home is the Sea: for Whales, by Sarah R. Riedman and Elton T. Gustafson (McNally, $4.50), is probably one of the most comprehensive books on cetaceans, namely whales, dolphins, and porpoises, available to high school students. It adequately covers cetacean physiology, diving abilities, external and internal anatomy, sound production, communication systems, ecology, migrations, many recent researches and discoveries, distinctions between dolphins and porpoises, and dolphins and dolphin-fish. The authors have carefully avoided making cetaceans, particularly those famous dolphins, humanistic in their communication systems. There are lists of common and scientific names, various vital statistics, and references. The illustrations are deftly placed and the drawings well done. In a few spots, such as the description of baleen and its straining

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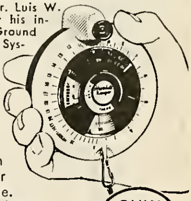

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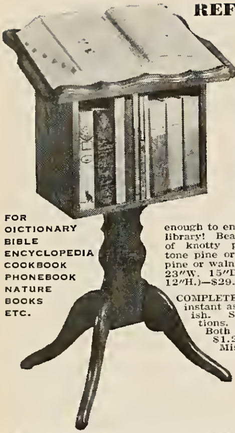

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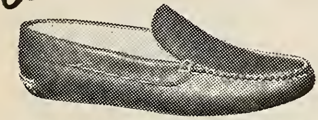

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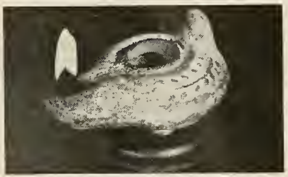

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mechanism, additional illustrations would have helped a somewhat obscure text, but by and large, it is a clearly written and informative presentation.

P. J. Hare's book *The Skin* (St. Martin's, $3.95) is a good example of the difficulty one faces when trying to keep one body system separated from the others. Although his beginning is a little fuzzy (I am not certain about the points he was trying to make in the first chapter) he soon points out the interrelationship of skin with other systems, and the reader accepts the fact that comprehension of skin function needs understanding of the body's physiology. The book covers hair, scales, nails, fur, feathers, sweat glands, pigments, temperature regulation, camouflage, water and salt balance, secondary sex characteristics, and secretions. It is competent and the author presents the material well. I believe, however, that a knowledge of basic biology and simple histology will be essential to understand some illustrations and the text.

Millicent E. Selsam's book *How Animals Tell Time* (Morrow, $2.95) is about animal rhythms, covering daily activity rhythms, tidal rhythms, lunar cycles, and seasonal cycles. The language is simple and straightforward; complex material is explained in a clear and precise fashion. The author illustrates the major topics with examples from the many experiments that have been carried out on this subject. The experimental stories of how rhythms are set in fruit flies, of the time sense in bees and how it functions in feeding, of the control of rhythms through nerve tissue in the cockroach, of rhythms in the body's biochemical activity, plus many other examples, are covered in the book. The illustrations, simple black-and-white drawings, complement the text. It's a splendid book on a current research topic—and without any errors! There is a good list for further reading. It is highly recommended.

Animal Appetites, by George F. Mason (Morrow, $2.95), is an almanac of facts about eating preferences and quantities consumed by animals ranging from insects to whales. Everything is given short shrift as the author skips from animals living in deserts and swamps to those living in prairies, tundras, and mountains. Pond life is covered, but the ocean is missing. The style of writing is chatty, and the text consists mainly of the author's own observations plus some material from libraries. It's brief and it's dull.

The Life of Animals with Backbones, by Michael Gabb and Michael Chinery (Ginn, $5.25), is a splendid example of what not to do in books. The potential subject matter is vast. The choices

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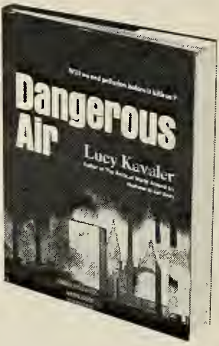

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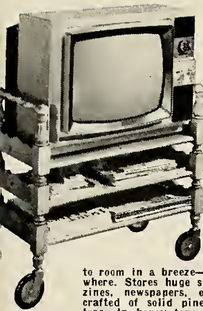

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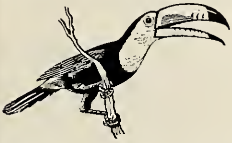

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made by the authors are poor. The profusion of illustrations are lessened in their worthiness by garish color combinations, lack of artistic quality, and poor placement in relation to the text. In fact, much of the text is in the small print associated with illustrations; if the reader overlooks it, some points will surely be missed. In addition, explanations are uneven and may be intensely technical or erroneously simple. The authors have condensed to the point of inaccuracy, for example, "man, monkey and lemurs are all members of the primates. They are mainly tree-living. . . . " One gets the impression that all snakes are venomous, and so on. Throughout there are pertinent omissions, such as not mentioning the spherical lens of a fish when describing its eye. But in general it is the lack of judgment in choice of material, inconsistency of language, disorganization, and ugliness of illustrations that severely mar this book. The index is poor; added references are not given.

Raccoons Are the Brightest People, by Sterling North (Dutton, $4.95), is characteristic of the many animal books that are written by authors who keep non-domesticated animals as pets. The writing style is clearly professional, and the photographs of raccoons are well selected. However, the author does not escape the tendency to humanize raccoons, and one gets an overdose of "aren't raccoons the brightest, cleverest animals" before the book ends.

The Strange World of Reptiles, by James Norman (Putnam, $3.64), with illustrations by Joseph Sibal, is a stimulating and extremely well-written book. Factual information on the habitats, biology, and behavior of snakes, lizards, and turtles, and legends about them, are presented in highly readable style. Much data on current researches are incorporated in the text. The illustrations are profuse (I wish they had been in color), and the index is excellent. It is a particularly good book for those who have a fear of snakes, for by the time they have finished it, they will want one to own.

Evelyn Shaw

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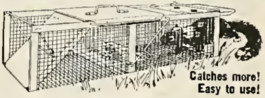

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EXCERPTS FROM "THE YEAR 2000"

Brave New World Revisited. A. Huxley. Harper & Row, New York, 1960.

Privacy and Freedom. A. F. Westin. Atheneum, New York. 1967.

The Historic Roots of Our Ecologic Crisis. L. White, Jr. *Science*, Vol. 155, No. 3767, 1967.

Controlling the Mind-Controllers. D. Krech. *Think*, July-August, pages 3-7, 1966.

Some Problems of the Extreme Utilitarian Position. *Ethics*, Vol. 70, pages 228-232, University of Chicago, 1960.

TRANCE CURE OF THE !KUNG BUSHMEN

!Kung Bushman Religious Beliefs. L. Marshall. *Africa*, Vol. 32, pages 221-252, 1962.

Trance and Possession States. R. Prince (ed.) McGill University Press, Montreal. 1967.

The Harmless People. E. M. Thomas. Alfred A. Knopf, New York, 1959.

GRAND CANYON

Grand Canyon. M. D. Beal. KC Publications, Flagstaff, 1967.

Evolution of the Colorado River in Arizona. E. D. McKee, R. F. Wilson, and C. S. Breed. *Museum of Northern Arizona Bulletin*, Flagstaff, 1967.

Grand Canyon. J. W. Krutch. Doubleday Anchor Books, Garden City, New York, 1962.

The Exploration of the Colorado River. J. W. Powell. Doubleday Anchor Books, Garden City, New York, 1961.

GEOMAGNETISM AND ANIMAL ORIENTATION

Biological Effects of Magnetic Fields. M. Barnothy. Plenum Press, New York, 1964.

Guideposts of Animal Navigation. A. Carr. D. C. Heath & Co., Boston, 1964.

Bird Migration. D. R. Griffin. Doubleday & Co., Garden City, New York, 1964.

TRIALS OF A ZEBRA HERD STALLION

A Field Guide to the Reproduction of the Grant's Zebra and Grevy's Zebra. J. M. King. *East African Wildlife Journal*, Vol. 3, pages 99-177, 1965.

Notes on the Biology of the Plains Zebra. H. Klingel. *East African Wildlife Journal*, Vol. 3, pages 86-88, 1965.

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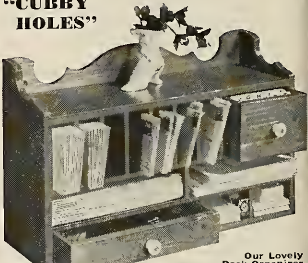

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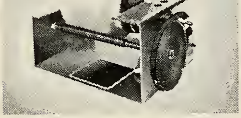

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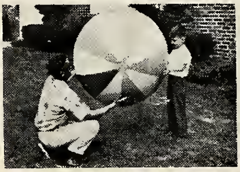

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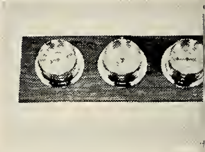

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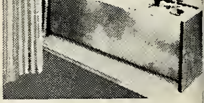

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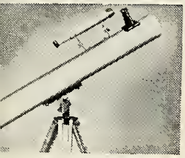

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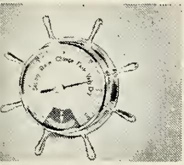

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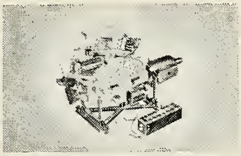

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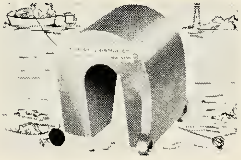

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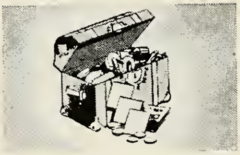

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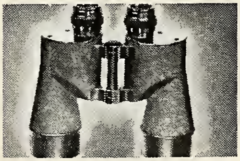

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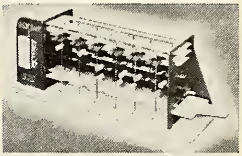

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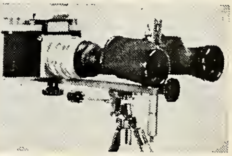

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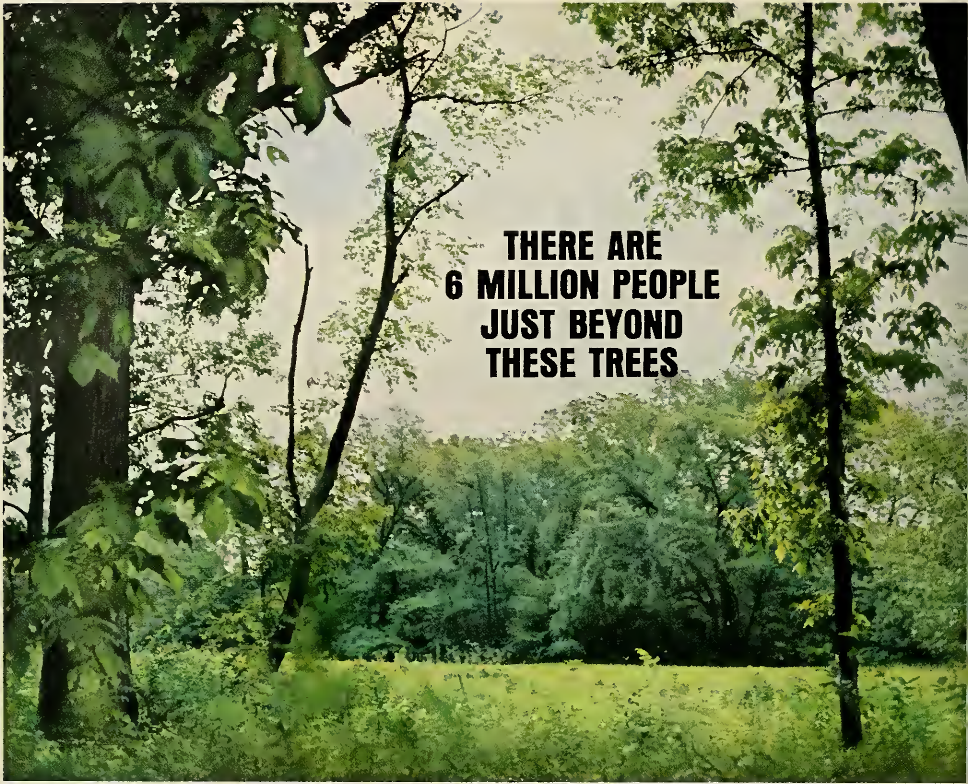

THERE ARE 6 MILLION PEOPLE JUST BEYOND THESE TREES

"No small-hearted city...could have established it or made the sacrifices necessary to maintain it." That's what Frank Lloyd Wright said about the vast and wonderful system of forest preserves now bordering the city of Chicago.

Sacrifices there certainly were, particularly during the frustrating years of struggle by public-spirited citizens to gain official approval for acquiring land for parks and playgrounds.

Dwight H. Perkins, a Chicago resident with no political power or special influence, was one of the prime movers in the crusade to educate the public on the importance of preserving the forest areas in Cook County. Perkins and his friends enlisted the support of newspapers, talked to officials and leading business men, printed and distributed thousands of leaflets, even conducted walking tours of the woodlands outside the city to give more people a first-hand knowledge of the natural beauty that could be preserved for themselves and future generations.

Although many Chicagoans were impressed and in favor, an incredible number of legal and official roadblocks thwarted the program time and again. Public Acts were passed, then defeated, rewritten and defeated again by wrangles over technicalities that went on for 20 years.

Eventually, however, the Forest Preserve District of Cook County, Illinois was firmly established. As a result, today
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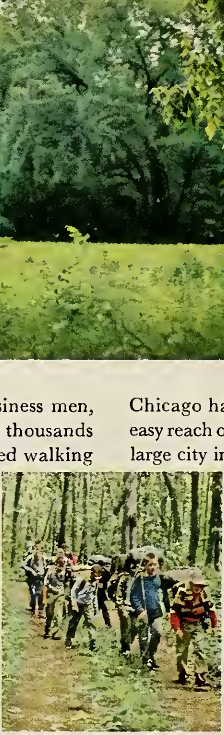

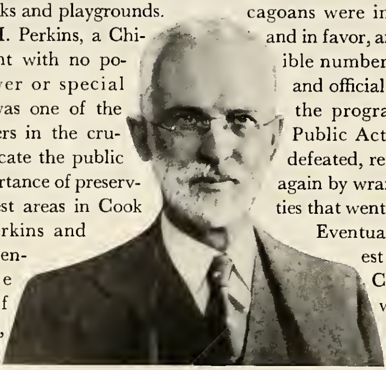

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THE ANTHROPOLOGY OF WAR

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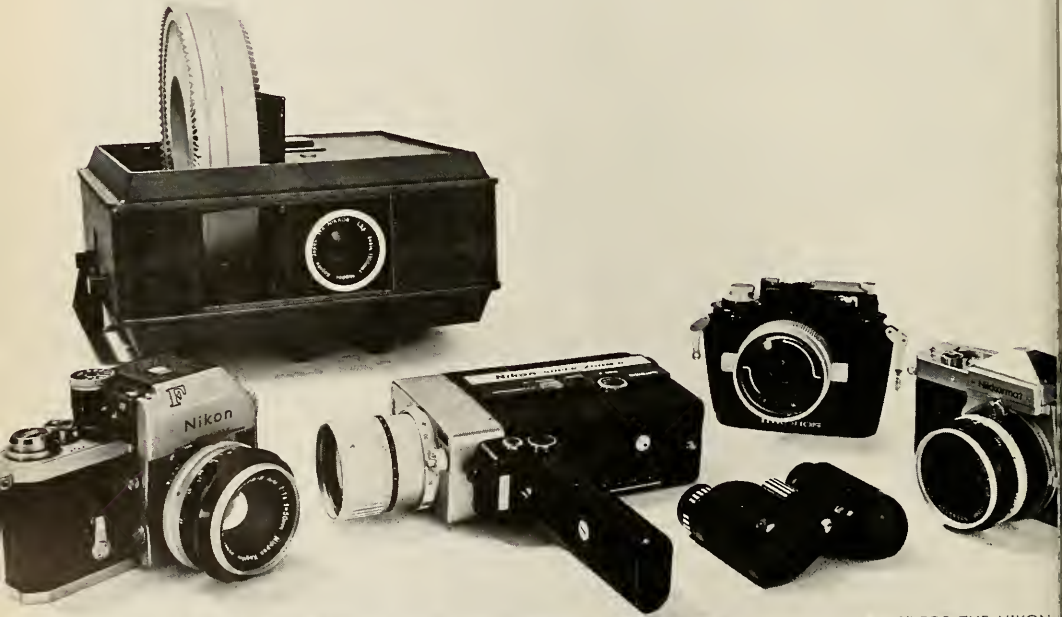

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Natural History

Vol. LXXVI No. 10 *JOURNAL OF THE AMERICAN MUSEUM OF NATURAL HISTORY* December 1967

WAR: T
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KINDNESS AND CRUELTY IN GREAT BRITAIN 6
Gerald Carson

A century and a half of dedicated work by the Royal Society for the Prevention of Cruelty to Animals is only one side of the coin when it comes to the treatment of animals. Bearbaiting, fox hunting, and cockfighting also characterized this aspect of British social history.

THE ART AND TECHNIQUE OF ELIOT PORTER 26
An interview by Patricia Caulfield

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The major contributions of the American Anthropological Association plenary session on war, just held in Washington, D.C., are brought together in a NATURAL HISTORY *Special Supplement.*

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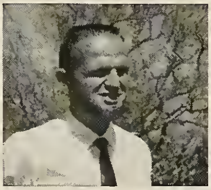

Paul S. Martin

William S. Creighton

William Mulloy

Bernard Vonnegut

At his 150-acre place near Millerton, New York, GERALD CARSON has written several books that deal with social history and popular culture—most recently, *The Polite Americans*, published by William Morrow in 1966. Mr. Carson received an M.A. from the University of Illinois and has since become affiliated with such scholarly groups as the Organization of American Historians and the Manuscript Society. He is a member of the advisory board of *American Heritage* and a contributor to *The New York Times Book Review*.

ELIOT PORTER is one of America's foremost nature photographers whose published works—particularly *"In Wildness Is the Preservation of the World"* and *Summer Island*—are rapidly becoming photographic classics. PATRICIA CAULFIELD, who conducted the interview with Porter, was formerly Executive Editor of *Modern Photography* and now devotes her time to a camera column in NATURAL HISTORY and to free-lance articles on photography.

PAUL S. MARTIN is among that small group of men from the fields of geology and biology who are concerned with the Pleistocene. He received his Ph.D. from the University of Michigan and is presently an Associate Professor of Geochronology at the University of Arizona. Among his major interests are Pleistocene pollen analysis, biogeography, and extinction. Dr. Martin has recently coedited and contributed to the book *Pleistocene Extinctions: Search for a Cause*, published by Yale University Press.

A man with a sense of humor as large as his reputation among his colleagues, WILLIAM S. CREIGHTON has published some fifty technical papers on the habits and taxonomy of ants. His comprehensive monograph *The Ants of North America* has been a standard reference since its publication in 1950. Dr. Creighton attended Roanoke College, Princeton, and Harvard University, where he received the D.Sc. in 1930. A Research Associate in Entomology at The American Museum of Natural History, and an Emeritus Professor at New York's City College, Dr. Creighton has now turned his attention to the habits of arboreal ants, especially those of the southwestern United States.

It would be difficult to find an archeologist busier than WILLIAM MULLOY. His work in the field dates back to 1936 when, as an undergraduate at the University of Utah, he worked on summer "digs." Dr. Mulloy has since become an authority on the archeology of the northern Plains. He completed his Ph.D. at the University of Chicago in 1953 and is now Professor of Anthropology at the University of Wyoming.

BERNARD VONNEGUT has been a Senior Research Scientist at the Atmospheric Sciences Research Center, State University of New York at Albany, since January, 1967. He was previously with Arthur D. Little, Inc., the General Electric Research Laboratory, and the Massachusetts Institute of Technology, where he had earned his Ph.D. and where he subsequently worked as a Research Associate in the Meteorology Department. Recently, Dr. Vonnegut has devoted his attention to the mechanisms that cause thunderstorms to become electrified and to electricity's role in thunderclouds.

In bringing our readers the major proceedings of an important and timely plenary session on war, the editors of NATURAL HISTORY feel the magazine has achieved a journalistic milestone. We feel so for two reasons. First, this magazine was chosen to be the session's official publisher, an honor doubly significant because the session itself is a milestone. Perhaps for the first time a scholarly and scientific organization has chosen to formally examine, from its unique and relevant perspective, so contemporary and so controversial a phenomenon as war. The second reason is that publication of the main contributions was timed to virtually coincide with their actual presentation in Washington, D.C., on November 30, 1967. Ordinarily, months intervene between such sessions and their publication.

For this special publishing arrangement NATURAL HISTORY is indebted to the organizers of the plenary session: Marvin Harris, Morton Fried, and Robert Murphy—all of Columbia University.

e Hasselblad system... d a few reasons why the serious photographer needs it.

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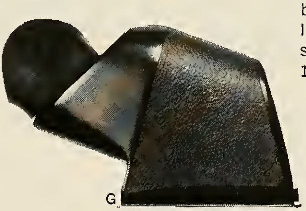
Here's what the Hasselblad System consists of. Firstly, the 500C, the standard camera in the system[A]. It accepts all seven lenses available for the Hasselblad, and is a single lens reflex viewing camera. The 500C always shows you exactly how your final picture will turn out on the ground glass screen, in the same way a view camera does. This allows you to concentrate on the setting up and composition of your picture, no matter what lens or accessories you are using on the camera.

The lens, magazine, focusing hood and winding knob of the 500C are all instantly interchangeable.

Next is the Hasselblad Super Wide C. The camera that caused a breakthrough in 2¼ square photography. Equipped with a 38mm, 90° angle of view Zeiss Biogon f/4.5 lens, this camera allows you to take pictures previously considered impossible. The superb optics of the lens assures perfect distortion-free horizontal and vertical delineation, with sharpness of image from corner to corner of the negative area, even at full aperture. Depth of field at an aperture of f/22 is from 26 inches to infinity.



The newest camera in the Hasselblad System is the electrically driven Hasselblad 500EL. This camera automatically advances the film and cocks the shutter, allowing a rapid series of exposures to be made, either by use of the camera release or long release cords, timer or remote radio control. The 500EL accepts all the lenses and most accessories available for the 500C. Obviously one of the advantages of this camera is that the photographer is freed from the actual mechanics of picture taking and can therefore, devote himself completely to the subject.

The use of the 500EL with the Hasselblad 70mm film magazine, (up to 70 exposures on cassette loaded 70mm film) allows the photographer, working on a job where a large number of exposures are required, to handle his work load much more quickly and efficiently.

There are seven Carl Zeiss lenses in the Hasselblad System, 40, 50, 80[B], 120, 150, 250[C] and 500mm. Each lens has a built in Synchro Compur shutter, with automatic stopping down at the moment of exposure and manual preview for depth of field checks. Every lens has both M and X synchronization allowing the use of flash and strobe at all speeds up to 1/500th of a second.

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Completing the system is a huge range of accessories that includes extension tubes and bellows extensions for close up work, filters[F], transparency copy holders, cut film backs eye level prism finders[G], sports view finders, sun shades[H], rapid winding crank[I], quick focusing handles[J], grips, underwater housings, ring lights, microscope attachments and carrying cases.

We are not suggesting that you need the entire system all at once. But we do believe that the quality of your photography and the pleasure that you get out of it, can be increased many times over when you own a small part of the Hasselblad System. (Such as those shown below.) The Hasselblad System is not cheap, but then if it will stop your wife complaining about the size of your contacts mightn't it be worth it?

This description of the Hasselblad System has been necessarily brief. If you would like a Hasselblad catalogue or further literature or if you have a specific technical inquiry, write to Paillard Incorporated, 1900 Lower Rd., Linden, N.J. 07036

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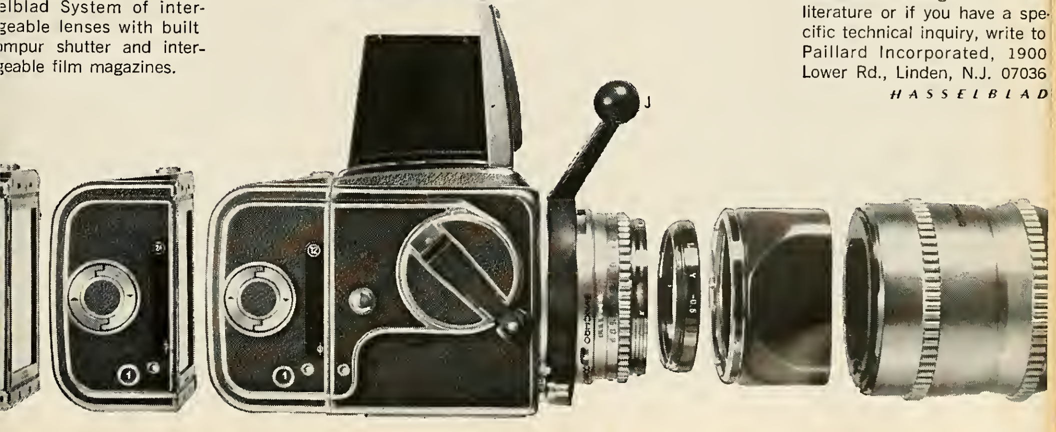

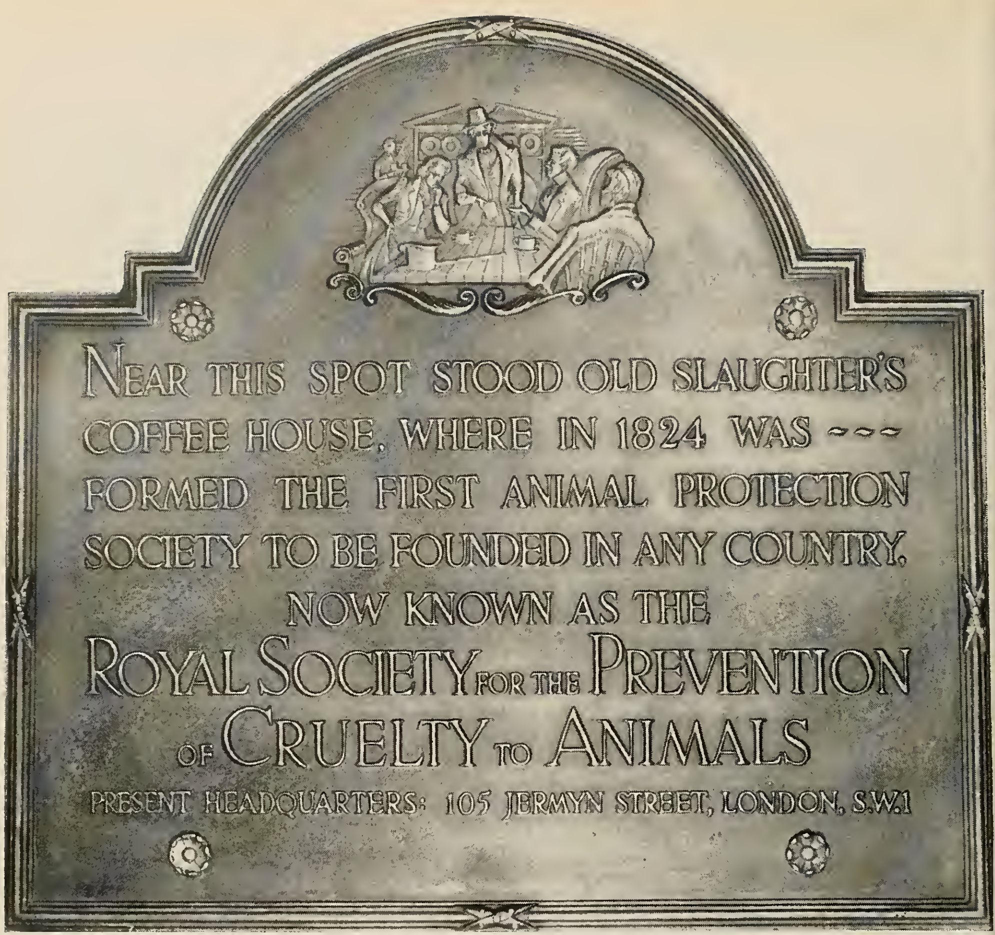
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Kindness and Cruelty in Great Britain

by Gerald Carson

How the Royal Society for the Prevention of Cruelty to Animals spoke up for those who could not speak for themselves . . . and touched the conscience of the Western world

The British enjoy the reputation of exhibiting an exceptional compassion for animals and concern over their welfare. The evidence of solicitude is totally convincing. A widow at Halberton, for example, shares the wine and wafer with Pip, her terrier, at Holy Communion. On animal Sunday, the Sunday nearest to the Feast of St. Francis (October 4), many worshipers bring their animal friends to divine service. All are reported as behaving decorously, seeming to know that they are in a holy place.

The holiday of swan-upping, when the swans on the Thames are counted and marked, is still celebrated according to hallowed tradition. The Earl of Cranbrook exercises bats in his bathroom, and the Medical Officer of Portsmouth has suggested the installation of artificial lampposts in the city's streets and parks as a dog amenity. Retired colonels write furiously to the newspapers from their clubs about the trade in worn-out horses, the abuse of pit ponies in the coal mines, the continued tolerance of the steel trap in Scotland. At the end of the road toward mercy the active humanitarian necessarily encounters, on philosophic grounds, the vivisection question and vegetarian dining; and he must maintain his equanimity when accused of being a busybody, a crank, or both.

Government statisticians estimate that there are four million dogs in Great Britain, more than six million cats, and about nine million caged birds, altogether equal to about one-half the human population of Eng-

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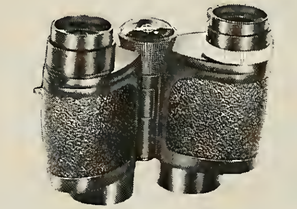

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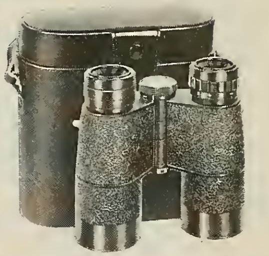

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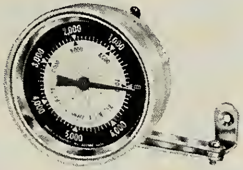

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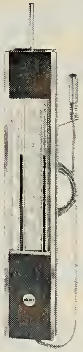

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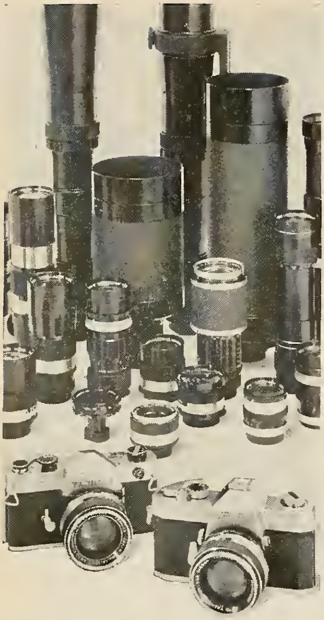

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land. The British read some twenty-eight weekly or monthly periodicals about animals and support not only the venerable and still-vigorous Royal Society for the Prevention of Cruelty to Animals but also the League Against Cruel Sports, the Fauna Preservation Society, the National Society for the Abolition of Cruel Sports, the Council for Justice to Animals and Humane Slaughter Association, the Universities Federation for Animal Welfare, the Home Rest for Horses in Hertfordshire, the Catholic Study Circle for Animal Welfare, the British Jack London League, the Royal Society for the Protection of Birds, the Battersea Dogs' Home, the Tail Waggers' Club of Great Britain, the Bird Lovers' League and, to round off this partial list, the Canine Defense League.

Yet the English, who would be shocked by anyone molesting the pigeons in Trafalgar Square, who knit warm woolen jackets for pets and spend meager pensions for dog food, also incite greyhounds to tear hares apart, beat badgers to death with spades, and smear the faces of advantaged boys and girls with blood from the tails of massacred foxes in a kind of upper-class puberty rite. King George V, who loved parrots, butchered partridges. Thinking about animals is strangely compartmentalized—fox hunters are revolted at cruelty to circus animals, bird shooters denounce deer hunters, and loyal members of the R.S.P.C.A. eat *pâté de foie gras.*

Nor is the law less illogical. Beat a cat and go to prison. Chase and kill a fox and become, conceivably, master of the fox hunt. These anomalies are not, of course, peculiar to the English character, but may be observed in all humankind who love the animals that are popular and esthetically pleasing but bypass difficult questions relating to the treatment of less-appealing forms of sentient life. A Mr. Bloor, of Slough, recently shot or drowned 700 sparrows in his back garden. "The blighters," Bloor said, "they're a nuisance."

The sense of kinship with animals, the basis of the best feelings human beings have about other creatures, is of comparatively modern growth. There are two opposing ways of thinking about the animal world. The older view is anthropocentric, em-

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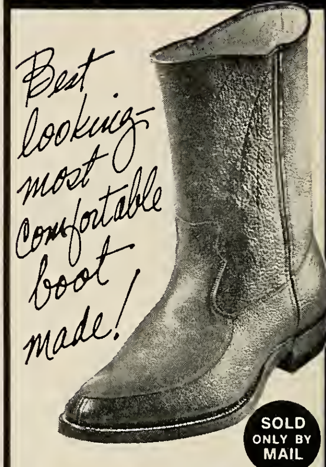

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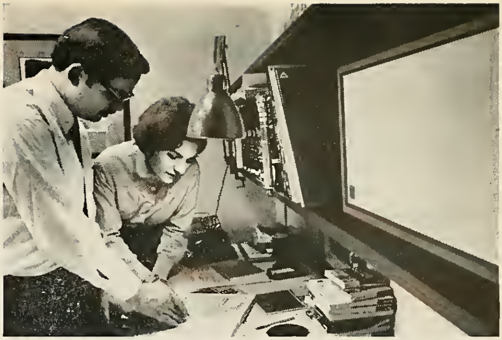

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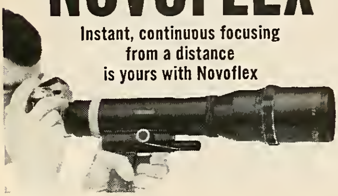

phasizing an authoritarian position that this is man's world and that the gap between *Homo sapiens* and the lower animals is unbridgeable. The other stresses the analogies in physical structure and in psychology between man and the beasts. If man alone can feel compassion, open a gate, or understand geometry; if only man blushes—"or needs to," as Mark Twain once remarked—it is also true that we share with our furred and feathered companions on this small planet a wide range of emotions and the common predicaments of hunger and thirst, disease and death.

There is some, but not much, humanitarian comfort to be found in Bible texts. The references that appear humane often have in view some other object than the relief of suffering. The Church's doctrine has been that animals lived, not for themselves, but for the convenience of men. Kindness for its own sake, then, was supererogatory. But there was always a heartening gap between theology and the operation of the folk mind. The medieval knight stubbornly loved his hawk, the king his menagerie, the prioress, as Chaucer tells us, her "smale houndes." These loyalties were unstudied and specific. Not until the eighteenth century did humane feelings become generalized enough to include genuine concern for anybody's—or nobody's—animal.

In medieval hagiography the saints are described as having a special relationship with birds and beasts, and it was popularly supposed that the lower creatures could detect and respond to holiness. Thus we have the charming legend of St. Pachomius, in which the holy man is pictured as summoning crocodiles to ferry him across a river, much as one would hail a taxicab. When St. Francis of Assisi preached to the birds, in the well-known story, they flapped their wings and chirped in spiritual ecstasy. St. Kentigern of Glasgow "caused a wolf to come and draw the plough in place of the ox which it had killed," and a wolf carried St. Froilanus' baggage for him. The Celtic saints seem to have been especially diligent in humanitarian labors. St. Nannan, for instance, established a flea sanctuary in Connaught, and a hermit of Brittany "showed a most tender regard for the physical, and even for the moral, welfare of the lice which infested his hair shirt."

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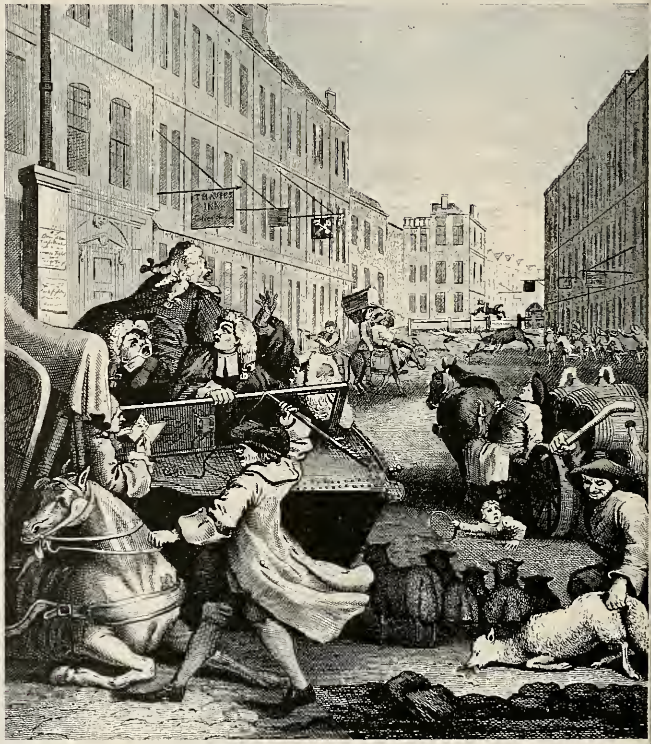
One of the strangest aberrations of anthropomorphic thought was the curious legal phenomenon of the beast trial. Summonses were issued with great formality to bugs and beasts, calling upon them to cease and desist from practices adjudged by men to be bad on the penalty of being cast out of the church, banished from the district, or executed. Domestic animals, whose identities were known, were tried by civil courts. Mice, ants, weevils, caterpillars, rats, eels, or sparrows, who were noisy or unchaste during the sermon, were brought before the ecclesiastical authorities. As late as 1771 a case was pressed against a dog in Chichester. Turtledoves were excommunicated in Canada in the late years of the seventeenth century and ordered to depart forthwith, which they did, since doves are migratory.

In one respect we may take seriously this naïveté in prosecuting animals. Animal justice, however fantastic it was, did imply, even if faintly, that if beasts had duties under the law, they also had rights in the human community. And this much may be said in explanation: men were treated no better than animals. More than two hundred capital offenses were still on the statute books at the beginning of the nineteenth century.

The dog occupied a preferred position in the affections of the English, for it was essential to the pursuit of game. John Bunyan complained that an Englishman would rather go for a walk with a dog than with a Christian. The cat had few friends in the seventeenth century. It was reputed to be the companion of witches and was expendable when a hunter was training young dogs. Cats were killed, too, because they looked like the owl, symbol of death. On Shrove Tuesday, a day of merrymaking just before Lent, the yeomanry practiced throw-



The by no means isolated inhumanity of Tom Nero—the culprit flogging the horse—has not gone unnoticed. A passenger with a conscience discreetly records the number of Tom's cab. This is the second etching of 18th-century British illustrator William Hogarth's series, "The Four Stages of Cruelty."

ng sticks at a cockerel, tied down so nly its head was visible. If its legs vere broken, it was mounted again n improvised splints so the sport ould continue; and sometimes at hrovetide the game was played with ats. At Beverley, in Yorkshire, dur-ng a fair, a shepherd succeeded in ating a live tomcat and pronounced imself "neither sick nor sorry."

But for centuries the great national port of the lower orders, and often f the upper classes too, was the bait-ng and worrying of chained, de-enseless bulls and bears by English ulldogs. Shakespeare recognized the opularity of the sport in *The Merry Vives of Windsor*, when he has Slen-ler say: "Why do your dogs bark o? be there bears i' the town?"

John Gay, also, refers to the parade hat preceded a baiting to drum up crowd: "Led by the Nostril walks he muzzled bear."

A variant was bull-running, a rec-eation closely resembling the gaunt-et of the American Indians. It was an nnual feature of life in the lusty own of Stamford, Lincolnshire, a ala event for more than seven hun-lred years, in which a great con-ourse of townspeople harried a rantic bullock while mastiffs tore off ieces of its flesh. Only energetic ac-ion in the nineteenth century by the S.P.C.A., the Home Secretary, a roop of the 14th Dragoons, and welve constables from London put n end to the riotous scenes.

Baiting was stoutly defended on he grounds that it was vigorous and nanly, that it accustomed men to loodshed and fitted them to fight the rench. There is here an interesting nstance of the survival of sympathet-c magic in the notion that the spec-ators at animal fights would acquire he courage and tenacity of the bull-log. The bear gardens were finally bolished in 1835. Cockfighting con-inued, universally popular with all evels of society, since it was a first-ate gambling sport.

The squirrels twirling treadmill ages outside shops, the dogs re-uired to turn a spit, the annual frolic f clubbing a ram to death by the oung gentlemen of Eton College, the vhipping of pigs to make their flesh nore tender, or cutting up collops of iving salmon—these, too, were the ommonplaces of a rude age. Per-orming animals were conditioned to lo cute tricks by methods best not in-

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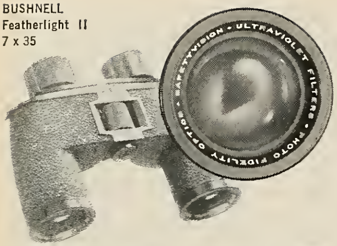

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quired about—the dog taught to mimic a man deep in liquor; the horse that could pick up gloves, count by pawing, or urinate on command.

Meanwhile the new science found in animals something interesting to be carved up or taken apart, sometimes for the advancement of knowledge, often just for kicks. Vivisection fascinated a public that found it racy to inspect the quivering viscera. After the Restoration, English hosts with a dilettante interest in cadavers entertained the "beautiful people" of the epoch with a dish of tea and a demonstration of the new air pump, while they suffocated rabbits, guinea pigs, birds, cats, sheep, and dogs without pity. Robert Boyle, inventor of the pump, was the age's hero. Poisons, purposeless blood transfusions, drownings, all had their place among these extravagant cruelties. One can only say of them that cruelty had climaxed and could go no further. Out of all the puppies so casually drowned in warm milk, cut up, and poisoned, one good, at least, can be recognized: It became clear to all that there was a close correspondence between man's body and the lower beasts', and that man was a good deal nearer the brutes and less near the angels than he had formerly supposed.

The first sign of a happier turn in the human–animal relationship appeared when the "natural philosophers" abandoned their mechanistic theory that the entrails of a mammal were analogous to the springs of a watch. John Locke completed the rout of the mechanists by pointing out that they had insisted animals were without feeling "only because their hypothesis required it."

The French Enlightenment, introducing the concept of brotherhood and natural rights, made it possible to include the animal kingdom in the social arrangements of men. A new mood of humane feeling toward animals was observable, especially in the lives and works of English poets and essayists. One finds it in William Cowper, who loved his hares so tenderly and wrote of his old cat, Puss, "I knew at least one hare that had a friend." Burns saluted a mouse as "fellow-mortal," and James Thomson, pacing in his lodgings on a wet Sunday, reflected with agitation upon the captive birds and beasts in Regent Park, exclaiming, "How they must

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uffer!" Blake, Shenstone, Coleridge, nd Wordsworth raised their voices n the new protest against abuse of nimals, while Hogarth's powerful artoons presented graphically his onclusion that cruelty to animals orrupted those who practiced it. The ondness of Jeremy Bentham and Dr. amuel Johnson for their cats provides a genial footnote to literary istory. Pope summed up the philoophical position when he launched is epigram:

> "Has God, thou fool! work'd solely
> for thy good,
> Thy joy, thy pastime, thy attire,
> thy food? . . ."

The evangelical churches, too, in urning away from the theological uiddities of the liturgical faiths, timulated a new lenity for other orms of life than our own. When a ittle girl, grieving over the death of er dog, Nix, inquired, "Will there e dogs in the other world?" Martin uther sympathetically replied: "We now less of what that other world is ike than this little one knows of the mpires or powers of this world. But f this we are sure, the world to come vill be no empty, lifeless waste . . . od will make new heavens and a ew earth. All poisonous and malicious and hurtful creatures will be anished there, all that our sin has uined. All creatures will not only e harmless, but lovely and joyful, o that we might play with them. The ucking child shall play on the hole f the asp, and the weaned child shall ut his hand on the cockatrice's den. Vhy, then, should there not be little ogs in the new earth, whose skin night be as fair as gold, and their air as bright as precious stones?" he shift in temper was slow and esitant, as with all great turning novements. When a vicar of the Esablished Church ventured in 1772 preach from the verse in Proverbs, A righteous man regardeth the life f his beast. . . ." his unhappy parishioners could only conclude that ither their priest had turned Methdist or was touched in the head. And 1809, when Lord Erskine, the ord Chancellor, presented a bill to revent malicious and wanton cruelty a restricted list of domestic aninals—the horse, ox, sheep, and pig -the dome of the rotunda of the louse of Lords rang with catcalls nd cockcrowings. Even so, the bill

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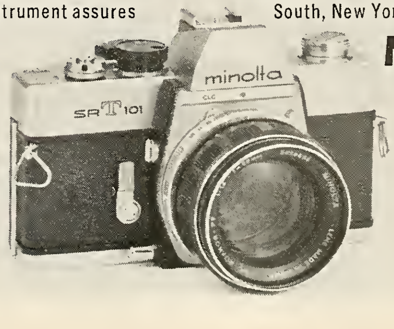

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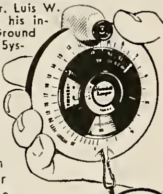

passed, only to die in the House of Commons.

Yet men did come to look upon the universal spectacle of animal misery with a more sensitive imagination. The middle classes, unaccustomed to the blood of the hunting field, were perhaps more open to the idea of animal protection than those in stations above or below them in the social hierarchy. And they were already responsive to progress in other categories such as slavery, factory legislation, and improvement of the condition of debtors, orphans, and sailors. There was movement in such matters as prison and legal reform, the better care of the insane, and aid for the mass victims of catastrophes. Men reached the compassionate view by various routes. And some of the humanitarians were fierce indeed in pushing their gentle aims. As the American historian Professor Crane Brinton remarked, "Robespierre himself was a notably humane person."

Lord Erskine, who took his dog with him to legal consultations, owned a goose and two leeches, and published a pamphlet on the agricultural services of rooks, later joined in another legal effort in behalf of his animal clients, generally known as the "Martin Act," introduced in the House of Commons by Richard Martin, a Protestant Irish member for County Galway, nicknamed "Humanity Dick" by George IV. This bill, too, was narrowly drawn, to fragmentize the opposition. It applied only to the larger domestic animals. But it did get through, accompanied by raillery and cries of "Hare! Hare!" Martin's Act received the royal assent on July 22, 1822, entering history as 3 Geo. IV, cap. 71.

This was the first such measure passed by any parliament in the world. Martin made many efforts later to widen the law's application, but all were defeated by clever parliamentary tactics on the part of those opposed. Yet honor enough remains for the man who established it as a legal principle that animals have certain minimal rights. Other men carried on, and amendments were successfully added in 1835, 1849, 1854, and after. Many attractive anecdotes still survive regarding Dick Martin. The combination in his personality of urbanity and wit, of pas-

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unless you and we help her. She'l die—and thousands more like he of many different species will die — unless money is made available fo the conservation and rescue projects essential for the protection of Wild Life in East Africa.

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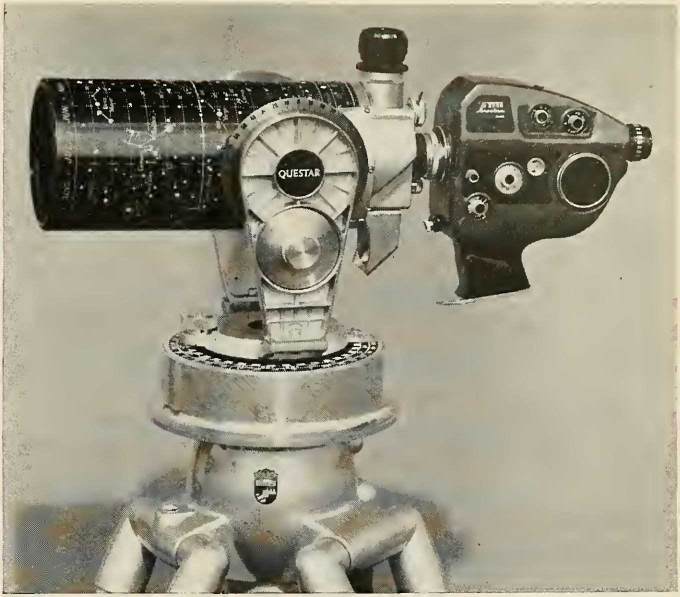
ion and staying power, made him the very pattern of the typical Irish gentleman.

Two years after the passage of the Martin Act the S.P.C.A. came into being, a private society exercising police powers and with national authority. The need had been recognized for an organized effort to educate and publicize, to enforce the law and seek its improvement. Something of the sort had already been tried in Liverpool, but it had faltered and disappeared. In 1824, then, a small group of persons of good will toward animals, including Dick Martin, of course, and William Wilberforce, the philanthropist, who had worked successfully for the abolition of slavery in the British Empire in 1807, gathered at Old Slaughter's Coffee House in St. Martin's Lane, famous as a resort of painters and sculptors. Out of this assembly came the S.P.C.A. The magistrates of England viewed the Act of 1822 with professional torpor, and the demand for action from the public was less than compelling. The social atmosphere is suggested in a comic song of the day:

"If I had a donkey wot wouldn't go,
D'ye think I'd wallop him? No, no, no!
But gentle means I'd try, d'ye see,
Because I hate all cruelty."

The first years were difficult. At one time the Hon. Secretary of the S.P.C.A., the Rev. Arthur Broome, was thrown into debtor's prison because the Society could not meet its obligations, which the most recent historian of the R.S.P.C.A. describes with British understatement as "a most unfortunate position for a clergyman of the Church of England." The Society fought on many fronts with slender resources. It set out to ameliorate nauseous conditions at the Smithfield cattle market, punish cat-skinners and the abusers of dogs as draft animals, outlaw the dog pits, alleviate the misery of cab, cart, and van horses, and activate the magistrates to do their duty.

Fortune smiled in 1835 when the Duchess of Kent and the then Princess Victoria allowed their names to be added to the list of lady patronesses. In 1840, after Victoria had be-



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We have some experimental reels here that they have taken showing men fishing on a pier about 2,000 feet distant, rice birds catching insects and gulls working busily on the Gulf of Mexico shore, both at about 500 feet, and, at the other extreme, tiny sand crabs, no larger than silver dollars, swarming at 30 feet. All demonstrate Questar's remarkable resolving power even with distant moving objects under difficult lighting conditions. With equal clarity you can discern facial expressions at 2,000 feet and the feather detail of birds in motion. And, of course, the close-up study of small animal or insect life at great enlargement is a fascinating possibility.

The pictures are taken on Eastman Kodak Kodachrome II with an ASA rating of 25. This is the only super 8 film available at present, but faster emulsions are promised for the near future.

The Davises found that exposures at approximately 16 frames per second proved satisfactory provided the subjects were in bright light. At that rate the shutter speed is 1/58 second. They point out that the same conditions control the success of telescopic photography with a movie camera, as with a still camera. All the light you can get and "good seeing" are essential for both, as well as equipment that is free from vibration.

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Miller Fluid Head, Model "D"	150.00

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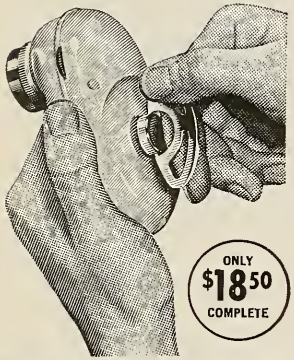

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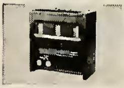
NH 12

Haverhill's

come Queen, she permitted the Society to add the important prefix "royal" to its name, and the Queen herself, when the R.S.P.C.A. wished to establish a Queen's Medal, carefully sketched a cat into the group of animals shown on the proposed design. The association with the royal family has continued ever since and given the Royal Society great leverage. Branches soon were added. The pattern was copied in Ireland, Germany, France, Austria, Belgium, Holland, and, considerably later, in America. The R.S.P.C.A. assisted in the formation of a parallel organization in 1884 for the protection of defenseless children. In this matter the United States was in the lead, for the New York Society for the Prevention of Cruelty to Children had formed a decade before this, also as an offshoot of animal humanitarianism.

The activities of the R.S.P.C.A., now in its 143rd year, have varied according to circumstances, the social milieu, and technological changes, such as the virtual elimination of the work horse by the internal-combustion engine. Humanitarian activities have a high visibility—a built-in publicity factor—which the R.S.P.C.A. has recognized in its publication program, its work with the younger generation, and in such appealing affairs as the colorful "Sands Parade" of donkeys and ponies on the beaches of Somerset in August and the traditional London Cart Horse Parade. This event goes back to 1885 when it was initiated by the Baroness Angela Burdett-Coutts, one of the striking figures of the Victorian age. Though the era of the horse has passed, the parade continues to be held—and televised!

For more than a century the British have been perplexed by a nagging difficulty—how to curb cruel amusements while exempting fox hunting, the ancient diversion of the upper crust so colorfully commemorated in nostalgic hunting prints. The official policy statement of the R.S.P.C.A. disapproves of hunting, a term that in England means pursuing animals with horses and dogs. Foxes are excepted on the ground that they must be controlled for the sake of agriculture, and alternative methods, in the opinion of the Royal Society, cause more suffering than does hunting. Many Britons dispute both these positions. So much heat has been generated by



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this issue that at a recent annual general meeting of the R.S.P.C.A., heavily attended by fox-hunting members, the gathering ended in wild disorder and the police were called in. A Miss Gwendoline Barter refused to leave the platform and was forcibly—but gently—removed by the police while she went limp in the manner prescribed for other occasions by the Direct Action Committee. Catcalls, slow handclaps, cries of "Shame, Shame" and "Resign, Resign," came from dissident members opposed to fox hunting, and the chairman confessed that he would rather be at home looking at his roses. Subsequently, the Council expelled several antihunting members.

Many observers believe that the end of blood sports is in sight. Both coursing hares and hunting carted deer are still legal, but the former is in decline because of the introduction of the mechanical rabbit, and the last deer hunt extant, the Norwich Staghounds, has announced that it will hunt tame deer no longer because of lack of support. Since the stags were no longer killed, unless by inadvertence, the sport had probably ceased to be fun.

When one notes the marked humane feelings of millions of people in the United Kingdom today, it might appear that the humanitarian cause is won. Yet a cursory glance at the wide-ranging activities that continue to engage the attention of the R.S.P.C.A. discloses how much remains to be done. Although vivisection is the particular interest of specialized societies, the R.S.P.C.A. is actively concerned with the black market in stolen animals and the conduct of laboratory experiments if they cause pain. It has effectively opposed the rodeo. The handling of food animals remains a problem, including the sticky question of ritual slaughter. The Society acts with conservation groups in enforcing the Protection of Birds Act and in meeting the new peril to sea birds from waste oil discharged from ships. R.S.P.C.A. convictions continue to cover a broad range of animals, including horses, ponies, donkeys, cattle, sheep, pigs, dogs, cats, poultry, birds other than poultry, tortoises, monkeys, and ferrets.

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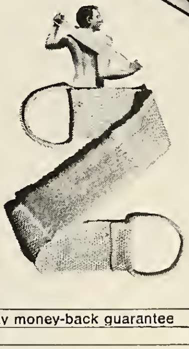

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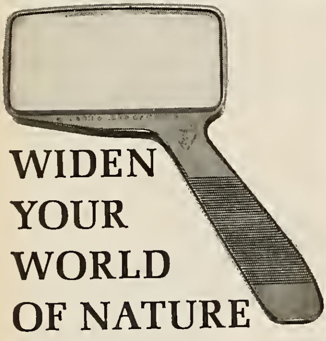

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kindness. But, with 143 years of experience behind it, the R.S.P.C.A. has become, necessarily, a connoisseur of animal crime. Cat thieves, it knows, work at dusk. Most violations of animal rights by adults entail ignorance, indifference, or neglect—often simply the omission of an act. The tortures that turn the stomach often are carried out by children. Psychopaths continue to abuse animals. Two defendants at Mossley, one a juvenile, recently pinned a kitten's ears together and suspended it by a piece of wire in the deep-freeze compartment of a household refrigerator.

An old effort continues, to awaken in children a response to the animal's point of view—anthropomorphism in reverse. The R.S.P.C.A. reviews films containing animal scenes. Unnatural tricks are scrutinized with particular care, where there may have been suffering in training or, interestingly enough, where the animal's dignity may have been violated. Problems of the future include some old ones that won't go away—the unwanted animal and overpopulation of dogs and cats. Difficult new questions arise from the application of intensive methods of animal husbandry, such as the battery system of producing eggs and broilers and the "sweatbox" for turning out fat but neurotic pigs. Space travel promises a new martyrdom for animals, and a new dilemma for those humans who need no urging from Wordsworth to agree:

> "Never to blend our pleasure or
> our pride
> With sorrow of the meanest thing
> that feels."

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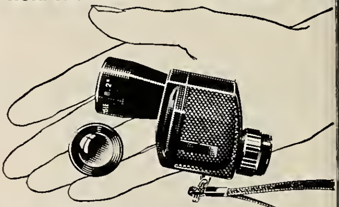

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three miles away. Jobs are few
ır away. Only poverty and des-
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two thousand miles away, in
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grown-up, and through *Save*
hildren Federation she is spon-
; one of the village girls, 8-year-
race Mahtewa.
he Mahtewas (two parents,
children, one grandmother
sister-in-law) live tightly
d in a tiny rock and mud
. The father who knows ranch
but can't find any most of the
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SOUTH AMERICA (3 wks. each): Colombia (world's top bird country, which we visit twice yearly), Feb. 17 and Aug. 10. And a series of tours around the continent beginning with Ecuador-Galapagos, in the Fall of 1969.

EUROPE: The Europe program makes possible many combinations: South Europe, May 9; Britain, May 30; North Germany and Sweden, May 30; Balkans, May 30; Norway, June 22; Iceland, June 22; Russia, June 22.

AFRICA: South Africa, July 20; Central Africa & Madagascar, Aug. 10; East Africa, Aug. 31.

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A Naturalist at Large

Night and the Iguana

by Marston Bates

So, we have cockroaches, as you learned last month. Nancy continues to trap them in the house, and I have now started to trap them in the "garden," or more elegantly, the "experimental rain forest." There are thousands out there; the walls and floor crawl with them at night. I suspect that they are responsible for cleaning up the food left for the birds and turtles; and they have multiplied far beyond the ability of the lizards and frogs to keep up with them.

I wish that I had kept a record of this population explosion. Several months ago, when we first became cockroach conscious, the large *Periplaneta* and the smaller *Blattella* were about equal in numbers. Now the *Periplaneta* are overwhelmingly more numerous. It looks as though they had won in competition, and it would be interesting to have this neatly documented. We know all too little about the nature of competition among species—and here we had a good chance to study it right under our noses.

The cockroach proliferation has led us to introduce possible predators. We have limited ourselves to small lizards and frogs because of danger to nestling birds, and these animals may not be able to handle the large adult *Periplaneta*. Our only large lizard is an iguana named Héloïse—perfectly safe because iguanas are primarily vegetarian.

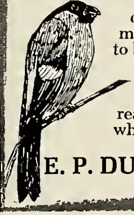
Héloïse is also the oldest animal inhabitant of the garden, having been given me, along with Abélard, on Christmas, 1964. Abélard arrived with an injury and died within a few days. Héloïse, now that she has grown, turns out to be a male, but we are too used to the name to change it for such a trivial reason.

We have become quite fond of Héloïse during the years she (he or it) has lived with us. I am not at all sure, however, that this feeling is reciprocated. Héloïse gives the appearance, from her perch high in a bush or on a greenhouse rafter, of looking down on people, disdainfully. It is said that iguanas become quite tame and used to handling; but not Héloïse. I tried picking her up every day for a month, but she never learned to like this, always squirming and scratching vigorously. She does, however, go into a sort of trance when I stroke her around the ears—seemingly in blissful contentment.

Iguana watching is a very dull occupation, since the lizards remain stretched out for long periods in some comfortable place, rarely moving. They illustrate beautifully the dictum of the British ecologist Charles Elton that "All cold-blooded animals . . . spend an unexpectedly large proportion of their time doing nothing at all, or at any rate, nothing in particular." A graduate student here at the university, Walter Moberly, wrote his thesis on iguana behavior and physiology and spent one summer observing wild iguanas in Colombia. Like Héloïse, they moved only rarely and then only to forage, to seek a better basking place, or to escape a possible predator.

Iguanas are most common in forests along streams, and when alarmed they drop either to the ground or into the water—Moberly saw them drop as much as sixty feet, without apparent harm. They can stay under water for considerable periods of time and seem to be good underwater swimmers; this is their favorite method of escape.

The vegetarian habit of iguanas is



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unusual among lizards. A friend has told me of an iguana he kept for several years that would eat mealworms, but this is the only instance of such a habit that I know of. Héloïse scorns mealworms, but she will eat canned dog food and hard-boiled eggs. Iguanas in the wild have been observed to eat carrion.

I find Héloïse's taste in vegetation quite unpredictable, except that she tends to like plants with a milky sap: poinsettias and papayas, for instance. I have several potted poinsettias that, when they have a good growth of leaves, I move into Héloïse's room as food for her. She also likes lettuce, cabbage, and collards. A friend gave me some seeds of *Cannabis sativa* (hemp — or, if you will, marijuana) left over from an experiment with the hashish fudge described in the *Alice B. Toklas Cook Book.* The seeds germinated and started a healthy growth, only to be demolished by Héloïse. She seemed, at the time, as imperturbable as ever; if she had a psychedelic experience, there were no visible signs. Héloïse also tends to like flowers, even of plants that she will not otherwise touch, such as water hyacinths or water lilies.

Héloïse lives in the Monkey Room along with plants that she won't eat and that monkeys don't damage. The monkey population now consists of two female cottontop marmosets (*Saguinus oedipus*) named Margaret and Dorothy. For a while I had three squirrel monkeys (*Saimiri sciureus*). Saimiris are about the gentlest of the South American monkeys, and I had hoped to be able to keep them under more or less "natural" conditions to study their behavior. But they proved to be far too damaging: they would tear up and break plants and kill birds and lizards when they could get them. I gave them to the Psychology Department after they caught one of my favorite hummingbirds.

Even the small marmosets can be difficult. A hummingbird flew through the door into their room the other day and was half-eaten before we discovered it. How they managed to catch it I don't know. We now have hung a beaded curtain between the Monkey Room and the Orchid Room, where most of the hummers are, and we exercise great vigilance to be sure we are not followed when we go through the door.

I try to be discouraging whenever people ask me about keeping mon-

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keys as pets. It seems a shame to keep them cooped in small cages, and they can be extremely mischievous if allowed to run loose. Monkeys are highly social. One, kept by itself, is likely to pine away if not given constant attention; two or more animals kept together tend to orient toward each other rather than to their owner, however solicitous he may be. Humane societies and zoos are apt to be flooded with offers of monkeys from disillusioned owners.

Marmosets are quite delicate in captivity. We have had several die, sometimes inexplicably, sometimes after the development of "cage paralysis," which seems to be due to a vitamin deficiency. Dorothy and Margaret are in fine shape now—they each get hummingbird formula mixed with banana paste, fruit, and thirty or more mealworms every day, two or three of the worms well oiled with vitamin solution. Perhaps there would be less difficulty if we were able to concentrate our attention on the marmosets; but there are so many other things calling for attention that it is difficult to favor any particular inhabitant of the experimental forest.

I would especially like to learn more about the amphibians and reptiles—lizards, frogs, and turtles—collectively known as "herps" from the science of herpetology. I would dearly love to establish breeding colonies of some of these. At the moment there are ten species of frogs, four of lizards, and one species of land turtle (the South American *Geochelone carbonaria*). In many cases there is only one specimen of a given species, so that reproduction is, to say the least, unlikely. Small tropical frogs and lizards are hard to come by from the usual animal dealers because they are not sufficiently spectacular to interest most people, so I have to take whatever I can get, from dealers or from friends.

The small herps are difficult to find even in the confined area of my garden—which makes me understand why their behavior has been so little studied in the wild. It would be impossible to locate hiding species in a rain forest, except for the ordinary collecting method of making their eyes gleam at night with a flashlight.

There is an interesting difference in how tree frogs spend the day. A

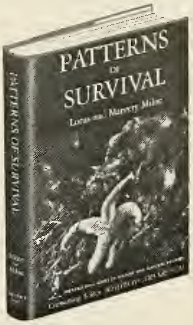
:her large gray species, *Hyla sep- utrionalis*, can almost always be und in the same place for periods several weeks before it shifts to me new hiding place. For a while is *Hyla* used the hollow in the end a tree fern trunk; then it hid for veral weeks in a bromeliad growing the same fern trunk; after this took to a hollow in a brick. At the oment it has some new hiding place at I haven't yet located.

This contrasts strongly with the havior of a bright-green Mexican ee frog, *Phyllomedusa callidryas*, the same room. I do not see the *yllomedusa* for weeks at a time, it whenever I do locate it, it is in a fferent place, all hunched up on top a leaf and almost impossible to ake out because it blends so per- ctly with the foliage.

Biologists recognize territory as an ea defended by an animal against trusion by others of the same spe- es, and home range as an area used an individual (or group) but not efended. It seems to me that *Hyla ptentrionalis* shows a third sort of atial orientation, which might be lled "home base." The three South merican turtles in the room show milar behavior, each usually being und, day after day, in the same lace. I presume these turtles, in na- re, dig burrows (as does the Flor- la gopher turtle). Any animal mak- g regular use of a burrow would ecessarily show home base behav- r. The protectively colored forms, ke *Phyllomedusa*, do not need to ave a regular hiding place.

I imagine that an animal with a ome base would also have a home ange, since it would need to have a ood knowledge of local geography find its way to the same hiding lace each day. The question then ecomes, do animals, such as the reen tree frogs, that show no regu- r home base have a home range to hich they restrict their wandering? don't know, but I suspect that I ave a better chance to find out in my xperimental garden than I would in he wild. I released a dozen green *lyla cinerea* in the Mango Room the ther day with the idea of seeing how hey deal with the space. They make great racket calling at odd times f day, but they are hard to find. To tudy them. I'll probably have to tay up all night—with the roaches.

Will man go the way of the dinosaur?



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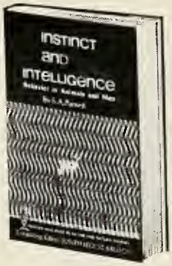

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The Art and Technique of Eliot Porter

An interview

by Patricia Caulfield

The components of Eliot Porter's photographic style are deceptively easy to list. First, his pictures lack scale. Second, he rarely includes horizon lines or sky. Third, his camera is more often aimed down than up. Fourth, he uses foregrounds, not as frames for backgrounds, but in complex relationships with backgrounds, both grounds occupying the entire picture area.

But to list what is different about Porter's pictures is not to explain his art. What most distinguishes his photographs is his special way of seeing, rather than subtlety of technique. The best way to understand that way of seeing is to examine his work and to read what Porter himself has to say. The following interview took place this autumn in Gatlinburg, Tennessee, where he was photographing the Smokies.

Q. Wasn't it in the late 40's that you began the project that was ultimately published as "*In Wildness is the Preservation of the World*" by the Sierra Club? Did you intend that project to result in a book, and how did you get started on it?

Porter: I got started on a book on Thoreau because my wife said, "Your pictures remind me of Thoreau. Why don't you do a book on Thoreau?" I didn't know much about Thoreau, all I knew was that he had written a book called *Walden,* so I obtained this book and read it. I found it rather a chore at first, but later, as I got into the swing of the idea, I started going through a set of his journals with the idea of picking out passages that could go with photographs. I pursued the project from both ends. I read Thoreau and marked passages I thought would make pictures that would have the same feeling, and I produced pictures that I liked and hunted for passages in Thoreau that I thought would go with the pictures.

Q. How did you organize your time? Did you go to New England on a number of trips in different seasons, did you spend one or two years there, or what?

Porter: When I finally became seriously involved in the Thoreau book, I made a point of going to New England at all seasons of the year. I went in the early and late spring. I was in Maine in the summer where, while it was not Thoreau's state particularly, a lot of the vegetation is the same as in Massachusetts. I went to New England in the winter and several times in the fall—with this particular project in mind—over a period of years. Of course there were long months in between when I wasn't doing that, when I had other things to attend to. I had a family in Sante Fe, and I went on camping trips with my children; I had a darkroom to build and equip, and I did other kinds of photography too in the Southwest, so that it wasn't continuously Thoreau for fifteen years.

Q. It took a long time to get "*In Wildness*" published —fifteen years—and I'm sure it didn't take fifteen

years for it to be more or less complete. What happened?

Porter: It probably did take all that time. I probably started too soon to try and get it published. I had enough pictures and enough quotations in the middle 50's, which I took around to many publishing houses. They all said it would be too expensive. They would sometimes keep it for a while and think about it, but in the end they would reject it. And all the time I was doing that, I was taking more pictures and adding quotations and taking out others I didn't like too well and changing the composition of the work. So that all the time it was being rejected, it was also being improved.

Q. When you are working on a project, about how much time do you spend in the field?

Porter: It is usually a matter of weeks. For instance, I went once in March to the Adirondack country and to Vermont, and the pictures I got there were of very early spring. The snow was still on the ground, but there was a feeling of spring. The buds were beginning to come on some of the trees. Then I went back a little bit later in the season, when the snow was off the ground and the first flowers were out and the poplar trees had put out their catkins. When in the

field I would photograph every day from early morning until dark. It was very intensive work.

Q. At the time you take your photographs are you pretty sure of what you're going to get? Are you ever disappointed with the results?

Porter: Of course I'm sometimes disappointed. One example was the results of my first trip to Glen Canyon. Glen Canyon is an overwhelming place. I found it very difficult to comprehend it, and on seeing my transparencies I realized I had taken pictures of fairly insignificant things on the trip. The pictures just didn't seem to show Glen Canyon as I remembered it.

I think there is no photographer in the world who isn't disappointed with what he does. If he were not disappointed, he wouldn't be a very good photographer. I still don't always get what I want, naturally. Many of the pictures I take aren't as good as I hope they will be, from two points of view. The concept of the picture itself may not be good and the execution may fall short. Perhaps I've taken it too fast, without enough consideration. It probably would be better if I took fewer pictures. Probably would be better if everybody took fewer pictures.

Q. How many pictures do you take in a working day?

Porter: I can't say. I might take 24, I might take more than that—4 x 5's these are. I might take only 5 or 6, or 3 or 4 in a working day. I would be trying to take pictures, looking for pictures, walking or hiking or doing something toward getting a picture. For instance, it's perfectly possible to spend a whole day trying to get one picture. Working with smaller cameras you usually take more pictures, especially with cameras using roll film such as 120 or 35 mm. Just mechanically it's easier to take more pictures. You take one exposure, then you say, "Well I'll take another one just to be sure." Or you take one at a slightly different angle. You don't tend to do that with a 4 x 5 camera where you have to move the tripod and refocus and adjust the swing back and all the things you have to do.

Q. Do you always spend a considerable period doing just one thing, photographing in the field, writing, printing, or whatever?

Porter: I used to go off and photograph in the spring and in the fall and sometimes in the summer and then print all winter, making separation negatives and transfer prints. I did this for many years.

Q. Do you always work on projects or do you sometimes just go for a walk and take "idle" pictures? For instance, if you're visiting a friend in another part of the country do you take your cameras along?

Porter: Usually not, no. I might have a 35 mm. camera with me when visiting friends, and I probably might take some pictures. I suppose everything is a kind of project, yes. But I do like to take pictures. For instance, I went to Greece recently, and that was supposed to be a pleasure trip, but I took cameras along and made a lot of pictures.

Q. Do you ever include people in landscapes?

Porter: Not if I can help it.

Q. There's a widespread attitude that they should be included to give scale.

Porter: I rather like pictures that don't have any scale at all. I think it adds to the mystery of the picture and perhaps confuses the person who is looking at it. He isn't quite sure how tall things are and in his mind exaggerates or perhaps diminishes the size of things if there is no one there to put him straight. It adds to the drama of the picture.

Q. I wonder if one of the reasons you never include people in your landscapes is that you prefer nature without man in it?

Porter: Yes, I do prefer nature without man in it. But I'm not averse to photographing signs of man's occupancy. A lot of my pictures that Alfred Stieglitz originally exhibited showed man's works. They showed houses and buildings and sheds and fishermen's docks and things like that. *Summer Island* has many photographs that show man's occupancy, his presence.

Q. We were discussing the lack of scale in your photographs, and I wanted to ask you about perspective and the translation of three-dimensional subjects onto a two-dimensional surface, as is done in paintings and in photography. Are you conscious of how you do this? Do you have any thoughts about how you use and manipulate apparent depth, or about creating visual tension between foregrounds and backgrounds? Do you try to make subjects look two or three dimensional? Unfortunately, communicating the question clearly involves a painter's vocabulary, which I've forgotten.

Porter: That's all right. I don't have a painter's vocabulary anyway. When I'm looking at a subject, I prefer to look at a confused subject—an intricate, confused subject. We'll say I'm looking at a woods—as we were today—I often look at it with one eye. I can hold my hands up in the form of a rectangle and sight through one eye, and that helps very much to see what you're going to get in the picture when you finally set the camera up in the same place to do the same thing. But looking at it with both eyes, you then have the impression of three dimensionality, and you may miss something that may be immediately apparent when you look at it on the ground glass—something that you don't like,

(Continued on page 92)

PLEISTOCENE OVERKILL

by PAUL S. MARTIN

About ten thousand years ago, as glaciers retreated into Canada and as man moved southward at the end of the last Ice Age, North America suddenly and strangely lost most of its large animals. Native North American mammals exceeding 100 pounds in adult body weight were reduced by roughly 70 per cent. The casualty list includes mammoths, mastodon, many species of horses and camels, four genera of ground sloths, two of peccary, shrub oxen, antelope, two genera of saber-toothed cats, the dire wolf, the giant beaver, tapirs, and others totaling over 100 species. Despite this fantastic loss of large animals during the Pleistocene, the most recent geologic epoch, the fossil record shows no loss of small vertebrates, plants, aquatic organisms, or marine life.

One need not be a Pleistocene geologist to ask the obvious question: What happened? To date there is no obvious answer, certainly not one acceptable to any consensus of scientists interested in the mystery. The question of just what occurred to

bring about this unprecedented extinction continues to provoke a storm of controversy.

Extinction, we know, is not an abnormal fate in the life of a species. When all the niches, or "jobs," in a biotic community are filled, extinction must occur as rapidly as the evolution of new species. The fossil record of the last ten million years bears witness to this fact, for it is replete with extinct animals that were sacrificed to make room for new and presumably superior species. But this is a normal state of affairs from a paleontologist's point of view.

However, the extinction that took place at the end of the Pleistocene did not comply with biological rules of survival. Unlike former extinctions, such as occurred in the Miocene, Pliocene, and Early Pleistocene, Late Pleistocene extinction of large mammals far exceeded replacement by new species that could easily have been accommodated by the prevailing habitat. The complete removal of North American horses, for example, represents the loss of a lineage of grass-eaters, without the loss of the grass! It left the horse niche empty for at least eight thousand years, until the Spaniards introduced Old World horses and burros. Some of these then escaped to reoccupy part of their prehistoric range. Today, tens of thousands of wild horses and burros still live along remote parts of the Colorado River and in the wild lands of the West. Certainly nothing happened at the end of the Pleistocene to destroy horse habitat. What, then, caused these animals, not to mention mammoths, camels, sloths, and others, to become extinct?

Like the horses, camels first evolved in North America many millions of years ago. They then spread into South America and crossed to the Old World by means of the Bering bridge. Crossing in the opposite direction were elephants, which soon prospered in the New World, judging by the abundance of mammoth and mastodon teeth in Pleistocene outcrops. From their evolutionary center in South America came a variety of edentates, including ground sloths and glyptodonts, the former spreading north to Alaska. But by the end of the Pleistocene, the majority of these herbivorous species had completely disappeared. Only relatively small species within these groups survived—the alpaca and llama among the camels of South America, and the relatively small edentates such as anteaters, armadillos, and tree sloths.

There was no obvious ecological substitution by other large herbivores competing for the same resources. Too many large mammals were lost, too few were replaced, and there was too little change among smaller plants and animals to accept this extinction as a normal event in the process of North American mammalian evolution.

One hypothesis commonly proposed for the abrupt and almost simultaneous extinction of large mammals is that of sudden climatic change. We know that climates did change many times in the Pleistocene—a three-million-year period of repeated glacial advance and retreat—so perhaps the great herds were decimated in this way. A sizable group of vertebrate paleontologists believe that that is indeed what happened. They maintain that with the retreat of the glaciers the early post-glacial climate grew more continental—summers became hotter, and winters colder and supposedly more severe than they had been during the time of the ice advance. The result was an upset in the breeding season, a lethal cold sterility imposed on species of large mammals adapted for reproduction at what came to be the wrong season. Perhaps also the large Ice Age mammals were confronted for the first time with excessive snow cover and blue northers, which even today can kill thousands of cattle and sheep in the High Plains. Paleozoologist John Guilday at the Carnegie Museum believes that accelerated competition occurred among the large mammals before they could readjust to the change in vegetation and climate. They proceeded to exterminate their food supply and themselves in a morbid togetherness. Then, according to Guilday, the early North American hunters who arrived over the Bering bridge delivered the coup de grâce to the few remaining large mammals after the great herds were already sadly depleted.

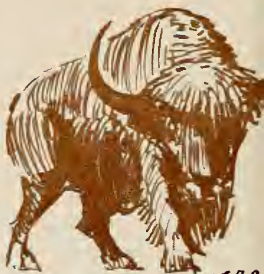
But we have no evidence that the large mammals were under competitive stress, then or at any other time in the Pleistocene. We know that they had witnessed, and certainly survived, the advance and retreat of earlier glacial ice sheets. And among today's large mammals most are remarkably tolerant of different types of environments. Some large desert mammals can endure months without drinking; others, such as musk ox, live the year round in the high Arctic. Reindeer and wildebeest migrate hundreds of miles to pick their pasture. Why should we believe that the great mammals of the Pleistocene were less adaptable?

Furthermore, while climatic changes had some effect upon existing fauna and its habitat, extinction apparently occurred when range conditions were actually improving for many species. From the fossil pollen record we know that mastodon and woodland musk ox of eastern North America occupied spruce forests ten to twelve thousand years ago, a habitat then rapidly expanding northward from its constricted position bordering the Wisconsin ice sheet. And the western plains grass-

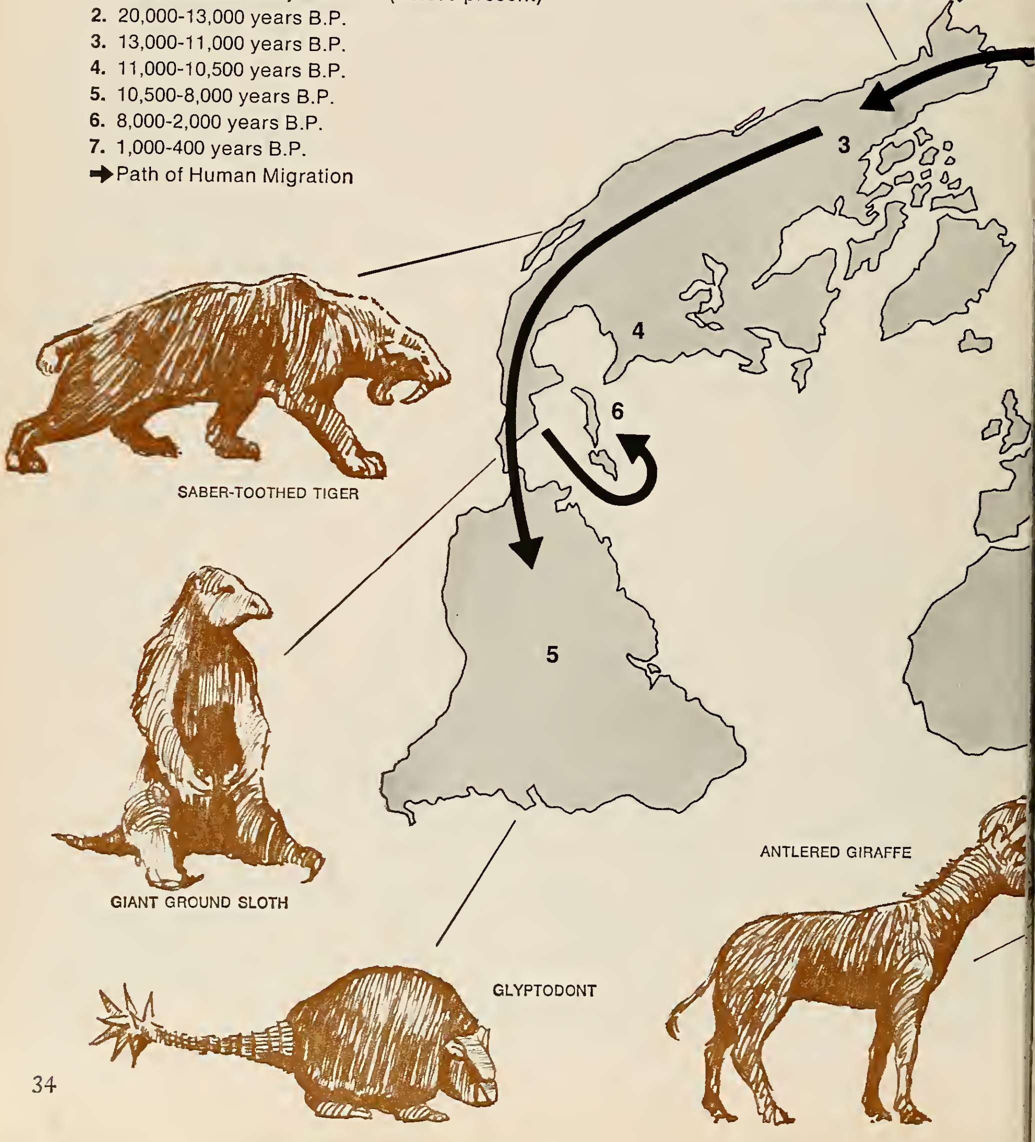
EXTINCTION
follows man's footsteps

TIME OF MAJOR EXTINCTION
1. More than 40,000 years B.P. (before present)
2. 20,000-13,000 years B.P.
3. 13,000-11,000 years B.P.
4. 11,000-10,500 years B.P.
5. 10,500-8,000 years B.P.
6. 8,000-2,000 years B.P.
7. 1,000-400 years B.P.

➡ Path of Human Migration



LONG-HORNED BISON

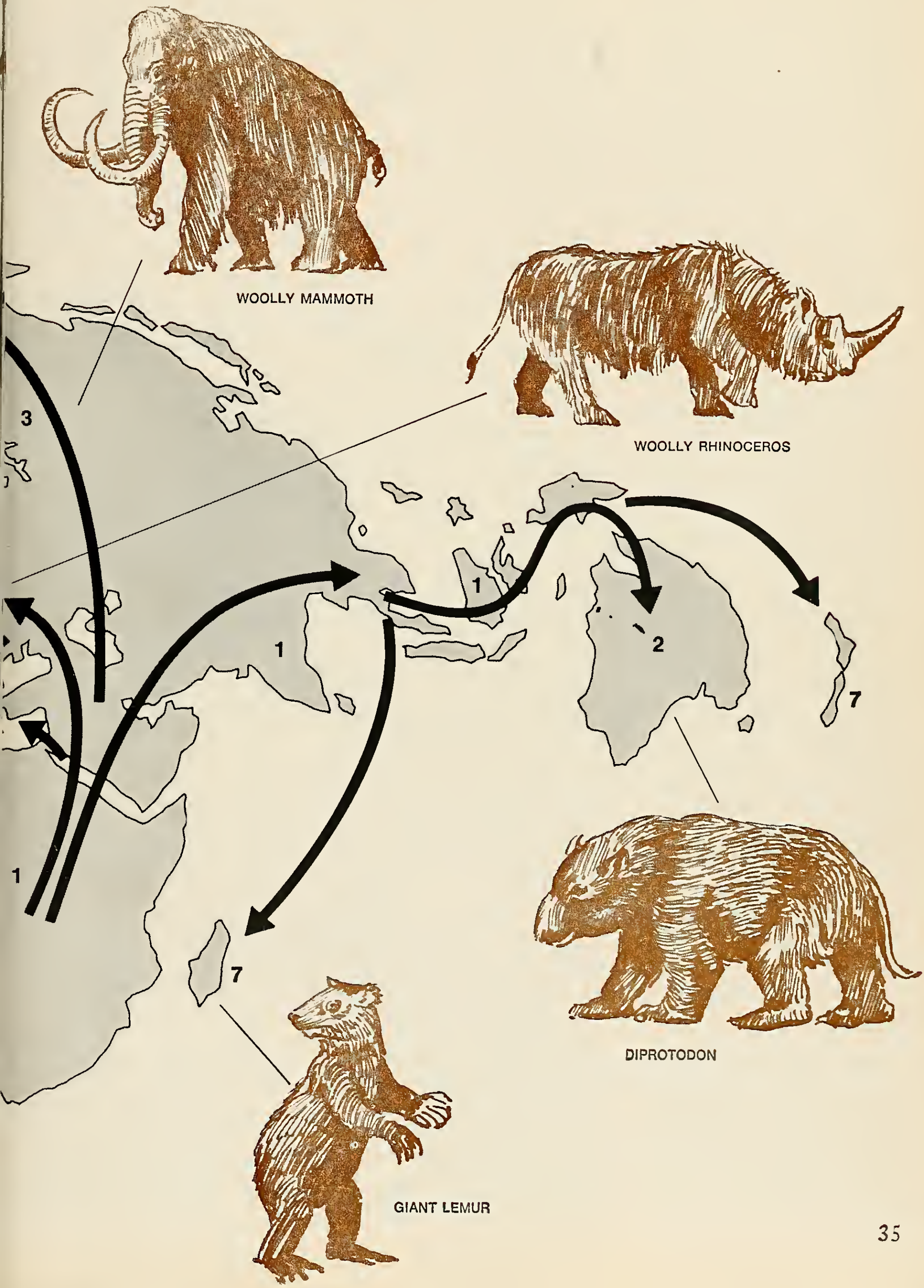


SABER-TOOTHED TIGER

GIANT GROUND SLOTH

GLYPTODONT

ANTLERED GIRAFFE


WOOLLY MAMMOTH
WOOLLY RHINOCEROS
3
1
1
1
2
7
7
DIPROTODON
GIANT LEMUR

land was extensive and spreading at the time of the extinction of grazing horses, mammoths, and antelopes.

Another objection to cold winter climates as an explanation for extinction arises when one looks to the American Tropics. There, far more species became extinct during this period than in the temperate regions. More extinct Pleistocene genera were found in a single fauna in Bolivia than are known in the richest of the fossil faunas of the United States. However, the Tropics never experienced the zero temperatures of North America. This being the case, the climatic change hypothesis cannot account for the large-scale extinction in that part of the world.

Nor can it account for the extinction that occurred on the large islands of the world, such as on Madagascar and New Zealand, which did not take place until less than a thousand years ago. In the case of the giant bird, *Aepyornis*, of Madagascar, and the giant moa from New Zealand, carbon 14 dates indicate that these birds did not perish until long after the time of major worldwide climatic upset.

Without doubt, the climatic disturbances that affected North America during the Pleistocene proved equally disturbing in New Zealand. During the last glaciation one-third of the South Island was ice covered and the remainder of the island was much colder than today. The subsequent melting of the glaciers brought a worldwide rise in sea level and divided the country in two. During the post-glacial period intense volcanic eruptions blanketed the North Island, so that by 2,000 years ago large parts of it were covered by sterile ash supporting only dwarfed vegetation. In fact, sheep raising failed in these areas until cobalt and other trace elements were added to the pastures. Yet, some 27 species of moas apparently survived the natural climatic catastrophes of the Pleistocene and disappeared only after East Polynesian invaders, the predecessors of the Maori, arrived sometime about or before A.D. 900. Thus, any credibility the climatic change hypothesis may have when applied to a single region vanishes when the global pattern is considered. Pleistocene experts generally believe that whatever their magnitude, major climatic changes of the last 50,000 years occurred at approximately the same time throughout the world—the extinctions did not.

My own hypothesis is that man, and man alone, was responsible for the unique wave of Late Pleistocene extinction—a case of overkill rather than "overchill" as implied by the climatic change theory. This view is neither new nor widely held, but when examined on a global basis, in which Africa, North America, Australia, Eurasia, and the islands of the world are considered, the pattern and timing of large-scale extinction corresponds to only one event—the arrival of prehistoric hunters.

Some anthropologists, such as Loren Eiseley of the University of Pennsylvania, have challenged the man-caused extinction theory on the grounds that African megafauna did not suffer the same fate as the large mammals of North America. At first, this appears to be a sound argument since that continent now contains some 40 genera of large mammals that were around during the Pleistocene. Africa's fabulous plains fauna has long been regarded as a picture of what the American Pleistocene was like prior to extinction, at least in terms of size and diversity of the big mammals. During the million years of hominid evolution in Africa, it seems as if man and his predecessors would have had ample time to exterminate its fauna. And if, as I believe, Late Paleolithic hunters in the New World could have succeeded in destroying more than 100 species of large mammals in a period of only 1,000 years, then African hunters, it seems, should at least have made a dent on that continent's mammals.

It turns out that they did, for today's living megafauna in Africa represents only about 70 per cent of the species that were present during the Late Pleistocene. Thus, while the proportion of African mammals that perished during the Pleistocene was less than that in North America, the loss in number of species was still considerable. In addition to the large mammals that now inhabit the African continent, an imaginary Pleistocene game park would have been stocked with such species as the antlered giraffe, a number of giant pigs, the stylohipparion horse, a great long-horned buffalo, a giant sheep, and an ostrich of larger size than is known at present. In Africa, as in America, the wave of Pleistocene extinction took only the large animals.

The African extinction has also been attributed to climatic and climate-related change. L. S. B. Leakey would explain extinction of the giant African fauna as the result of drought. If so, the drought strangely did not affect nearby Madagascar. On that island, barely 250 miles from the African shore, extinction of giant lemurs, pygmy hippopotamuses, giant birds, and tortoises did not occur until a much later date, in fact not until within the last 1,000 years.

African big game extinction appears to coincide in time with the first record of fire, or at least of charcoal, in archeological sites. In addition, most extinct fauna is last found in many locations associated with the distinctive stone tools of Early Stone Age (Acheulean) hunters. If fire was used in hunting, man-caused extinction becomes easier to understand, because fire drives necessarily involve large amounts of waste—whole herds must be decimated in order to kill the few animals sought for food. Perhaps fire became a major weapon in the hands of the Acheulean big game hunters enabling them to encircle whole herds of animals.

In any event, African extinction ended during the period of the Early Stone Age hunters. This fact raises the possibility that the cultures that succeeded the Acheulean developed more selective methods of hunting and may even have learned to harvest the surviving large mammals on a sustained yield basis. Even during the last 100 years, when modern weapons have reduced the ranges of many species, there has been no loss

Although the musk ox disappeared along the migratory path taken by Stone Age man, glacial ice sheets effectively sealed off portions of the animal's range and protected it from the nomadic hunters. With the retreat of the glaciers, the species spread westward through northern Canada and into Alaska.

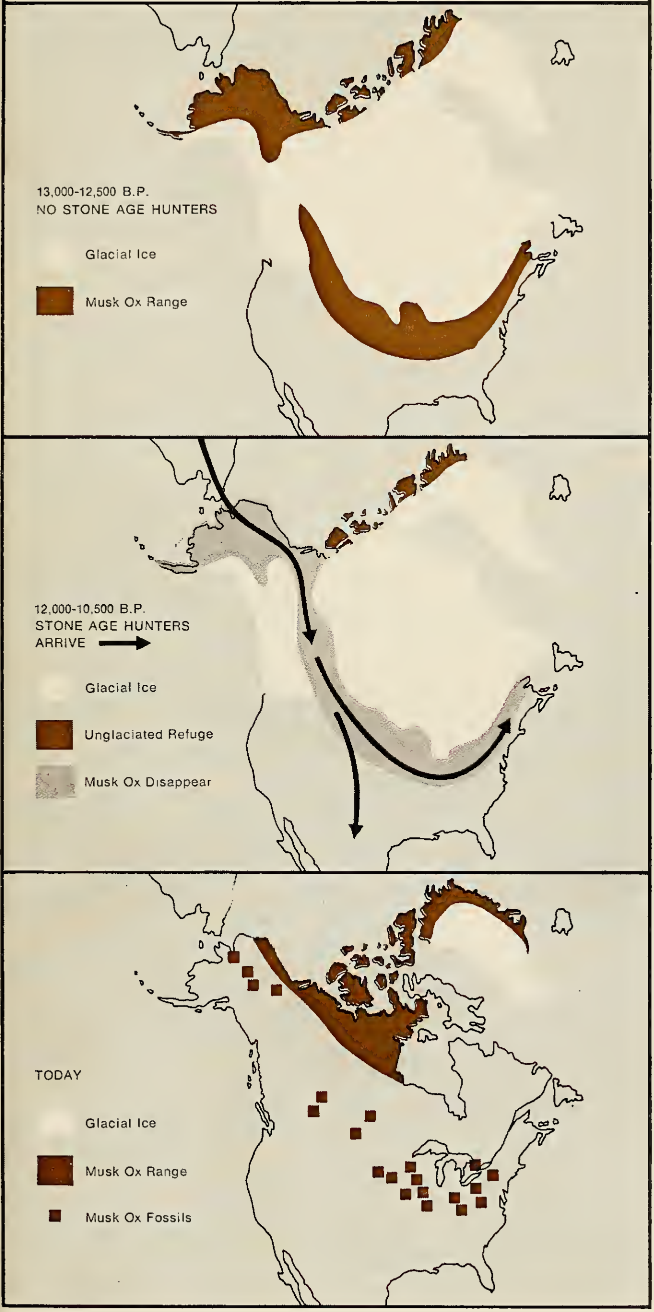
of whole genera of terrestrial mammals, as occurred during the time of the early hunters.

The case of Australia also supports the hypothesis of man-caused extinction. On that continent, no evidence of extinction, without replacement by other species, can be found until after men had inhabited the island, at least 14,000 years ago. About this time, various species of large marsupials perished, including the rhino-sized *Diprotodon* and the giant kangaroo.

About 12,000 years ago, when the Paleo-Indians swept into North America across the Bering bridge, through unglaciated Alaska, and down the melting ice corridor east of the Cordilleras, we can be confident that they were old hands at hunting woolly mammoths and other large Eurasian mammals. In contrast, the New World mammoth and other species of big game had never encountered man, and were unprepared for escaping the strange two-legged creature who used fire and stone-tipped spears to hunt them in communal bands. Probably the New World fauna of the time was no more suspicious of man than are the fearless animals that now live in the Galápagos and other regions uninhabited by men. In any case, radiocarbon dates indicate that North American extinction followed very closely on the heels of the big game hunters. The Paleo-Indians easily found and hunted the gregarious species that ranged over the grasslands, deserts, or other exposed habitat. As the hunters increased in number and spread throughout the continent, large animals whose low rate of reproduction was insufficient to offset the sudden burden of supporting a "superpredator" soon perished.

Early man may not have been able to avoid killing the herd animals in excess. To capture *any* members of a bison or elephant herd, it was necessary to kill them all, for instance, by driving them over a cliff. Even when big game became scarce and small animals became more important in the human diet, the pride and prestige associated with killing an elephant may have continued. This, in fact, seems likely, judging from the prestige associated with the unneces-

HOW TO SURVIVE THE PLEISTOCENE



sary killing that persists even today within our own society. By virtue of his cultural development, man became a superpredator, less susceptible to the biological checks and balances that apparently prevent such predators as Arctic foxes from annihilating their prey, the Arctic hare.

If the overkill hypothesis is valid, how did *any* large mammals manage to survive? There are several explanations. Some species, such as tapirs, capybaras, deer, white-lipped peccaries, anteaters, and tree sloths, took refuge in the vast forests of tropical America. In temperate regions, solitary moose and bear also found refuge in wooded areas, perhaps with a few small herds of woodland bison, at the time when soon-to-be-extinct species of giant bison were being annihilated by Folsom hunters on the plains. Mountain sheep found protection on the roughest desert ranges while mountain goats escaped only in the northern Rockies.

The musk ox, that conspicuous and easily hunted game animal of the open tundra, was wiped out in Eurasia, but in America it escaped through a piece of paleogeographic good luck. Since parts of the Canadian Arctic Archipelago and Greenland were untouched by glaciation, tundra habitat was available through the Pleistocene for this species and for barren ground caribou. Some of these animals remained in the "safe region" north of the continental ice sheet, a zone unknown to the early hunters. They thus escaped the fate suffered by most species located along the path taken by nomadic hunters as they pushed into Alaska, down western Canada, across the northern United States, and into New England. The Keewatin and Laurentian ice sheets provided a barrier to the early hunters whose distinctive spear points and other artifacts are unknown in the eastern Canadian Arctic. With the final melting of ice, less than 6,000 years ago, the Greenland musk oxen were at last exposed to the New World Indians and Eskimos. But the wandering superpredators—the Paleo-Indians—were no longer present. The Eskimo had the good fortune, or good sense, to harvest musk oxen on a sustained yield basis, and the species was able to spread westward through northern Canada, ultimately recovering part of its Alaskan range. If the woolly mammoth had also occupied the Greenland refuge, it too might have survived the Pleistocene.

Can the overkill hypothesis be disproved by future experiments or discoveries? To discount the hypothesis one need simply identify a major wave of extinction anywhere in the world in the Late Pleistocene prior to man's arrival. To date, such evidence has not been found. Quite the opposite, in fact, since the chronological sequence of extinction follows closely upon man's footsteps—occurring first in Africa and southern Asia, next in Australia, then through northern Eurasia and into North and South America, much later in the West Indies, and finally, during the last 1,000 years, in Madagascar and New Zealand. The pattern shows that Late Pleistocene extinction did not occur in all locations at the same time, as it would have if there had been a sudden climatic change or perhaps a cataclysmic destruction of the earth's atmosphere with lethal radiation caused by cosmic ray bombardment, another common hypothesis. Since no synchronous destruction of plants or of plant communities is known, the long-held belief that climatic change caused extinction lacks credibility.

I do not pretend that the overkill hypothesis explains how, why, or even how many early hunters were involved. It seems reasonable to assume that fire and fire drives were a major weapon: possibly plant poisons were used in the Tropics. To the objection that too few spear points or other Stone Age artifacts have been found in the Americas to prove there was a sizable prehistoric human population, one may assert, tongue in cheek, that too few fossils of Pleistocene ground sloths, mammoths, camels, and saber-toothed cats have been found to prove there was a sizable prehistoric population of them either. The obvious difficulty with the "spear point" argument is that even the best fossil localities, with or without artifacts, do not yield data that can be reliably converted into population estimates. The case for overkill is best presented as a "least improbable hypothesis," and is not based on extensive knowledge of how prehistoric hunters may have carried out their hunting. Nor is there much hope that we will ever learn more of their techniques than the little we now know. The essence of the argument is based upon the simple matter of Late Pleistocene chronology. In no part of the world does massive unbalanced faunal extinction occur without man the hunter on the scene.

To certain comfortable concepts about pristine wilderness and ancient man, the implications of this hypothesis are startling, even revolutionary. For example, that business of the noble savage, a child of nature, living in an unspoiled Garden of Eden until the "discovery" of the New World by Europeans is apparently untrue, since the destruction of fauna, if not of habitat, was far greater before Columbus than at any time since. The subtle lesson of sustained yields, of not killing the goose that lays the golden eggs, may have been learned the hard way, and forgotten, many times before the twentieth century.

A related conceptual mistake, if the hypothesis holds, may be the long-held opposition of range ecologists to the introduction of exotic large mammals in America. Part of the opposition to the introduction of alien species is based on the idea that native North American mammals are already using all the available browsing and grazing space that could or should be occupied in this country. But remembering the numerous species of the Pleistocene, it is difficult to imagine that native mountain sheep, bison, antelope, deer, and elk occupy all available niches in the American ecosystem. The concept of game ranching, of keeping both cattle and native game species on the same range in order to make maximum use of pastures, is catching on in Africa. Since our own ranch industry is essentially a monoculture of either cattle or sheep, perhaps it's time to take a fresh look at the unfilled niches on the American ranges. Domestic livestock, wild game, and the range itself may well benefit from a greater diversity of fauna and a partial restoration of the complex ecosystem that was America for millions of years, until man arrived.

A special Natural History
supplement based on
a historic plenary session
held on November 30, 1967,
in Washington, D.C.,
at the 66th Annual Meeting
of the American
Anthropological Association

WAR: The Anthropology of Armed Conflict and Aggression

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NATURAL HISTORY, *December 1, 1967*

In response to a petition circulated at the 1966 annual meeting of the American Anthropological Association, an effort was made to have the 1967 sessions deal with contemporary issues of critical importance. No topic seemed more important to—yet more neglected by—anthropologists than war, its causes and consequences. The contributors to this special symposium, which was organized by anthropologists Marvin Harris, Morton H. Fried, and Robert C. Murphy, were not asked to reach conclusions for or against any particular ethical or political position and do not necessarily share any single view of the social responsibility of anthropologists with respect to the study of war.

The articles in this supplement are brief versions of longer papers presented on November 30, 1967, at the American Anthropological Association meeting. These papers, and a complete record of the discussion they elicited, will be published by the Natural History Press in 1968. Ed.

Human Aggression: The Need for a Species-specific Framework

by R. L. Holloway, Jr.

As this paper is being written, there is a surrounding aura of violence, for it is summer, 1967, and violence is literally everywhere. Has there ever been an era without violence, and is not violence a natural penumbra of the human condition? History indicates that violence and conflict have always been a concomitant of human existence, although the tempos have been both adagio and allegro.

My task here is to compare the aggressive components of man's behavior with that of other animals. Academic and public interest in this theme is pronounced. A rash of biologically oriented books has been placed before the public: Konrad Lorenz's *On Aggression,* Robert Ardrey's *The Territorial Imperative,* and The Institute of Biology's Symposia, *The Natural History of Aggression.* The major issue is the very nature of human aggression. Is it innate—an instinct—or is it learned? Do animal studies provide us with illuminating frameworks to further our understanding of human aggression or not? Do we need a theory of aggression that is specific to human beings? Can anthropology, particularly the study of human evolution, give us any insights on these important questions?

Most discussions on the nature of human aggression have tended to gravitate between two poles: (1) aggression as direct (sometimes identical) instincts inherited through evolution from other animals, and (2) aggression as purely learning or cultural conditioning. Neither viewpoint seems to fit the human case, or that of any other vertebrate animal. Proponents of both extremes have usually ignored evidence from many disciplines that aggression, however defined, has both physiological and learning components involved in its genesis and expression.

Aggression is most often defined as "behavior whose goal is the injury of some person or object" (Berkowitz, 1962, 1965), which stems mainly from the treatise by Dollard *et al.* (1939) on aggression and frustration. Scott (1958) uses the word to refer to fighting, or the act of initiating attack. Buss (1961) defines aggression as a response that delivers noxious stimuli to another organism. Note that neither Buss's nor Scott's definition includes any reference to intent. As human beings greatly concerned with aggression, its genesis, and, hopefully, its control, we concern ourselves very much with intent. But whether other animals engaged in aggressive actions harbor intents in the manner we are accustomed to is an unanswerable question. It is feasible that actions may occur that do not contain aggressive intent in terms of injury, but that are interpreted as such. On the other hand, it is pointless to deny that much aggressive action has the intent of injury behind it. The reason for discussing this aspect of definition is, not to quibble whether this or that instance of defined aggression was intended on the part of the actor, but instead, to point out one tricky aspect of studying aggression. Interpreting an action as aggressive depends on an appraisal of the cue functions or environmental stimuli that help to activate an animal to aggression, as well as on the internal state of the animal in terms of its readiness to action and its appraisal of the outside cue or stimulus.

While we generally think of aggression as maladaptive, it is obvious that under certain conditions aggression is an asset to an animal, as when it prolongs life and increases the opportunity for passing genes to the next generation. Animals are often threatened both by members of their own species as well as by those of different species. Man is hardly an exception, and it should occasion no surprise that he is biologically capable of perceiving threats to his existence and reacting aggressively to such threats.

All this would be of only minor importance if there did not appear to be a recrudescence of the idea that humans possess an instinct toward aggression and warfare. Both Lorenz and Ardrey have tried to establish aggression as an instinct in man. An instinct is generally understood to be a quite specific response pattern—invariant in its development, maturation, and expression—that occurs to some quite specific cluster of stimuli from the environment. As such, it is regarded as an innate, genetically determined pattern, which comes about without reference to, or in the absence of, learning. The success and increasing sophistication of the ethologist school has focused on the innate and relatively fixed action patterns of numerous animals, and elaborate studies

R. L. Holloway, Jr., assistant professor at Columbia, specializes in physical anthropology, particularly the evolution of brain and behavior.

have attempted to demonstrate the almost "key-in-lock" relation between certain stimuli and fixed action patterns of motor sequences. The example of male stickleback responses to the red belly of another male is well known. In addition, there has been a great deal of success in interpreting such behavior patterns and the environmental releasers within the framework of adaptation and natural selection. It is particularly this latter emphasis, the adaptiveness of behavior in the ecological context, that augurs such optimism for the ethologists in their study of animals other than man.

But does man have any instincts? Particularly, does he have an instinct toward aggression? If understood in the usual sense of a fixed invariant pattern of action directed toward some definite invariant cluster of stimuli, there appear to be precious few, if any, examples of instincts in man, and no evidence for an aggressive instinct. There is neither motor nor sensory constancy, in the ethological sense, for human aggression. The range of stimuli that can produce acts of aggression for man is enormous, as are the ways in which he can manifest his aggression. Red feathers, blue gewgaws, green turf, butyric acid, white eyelids, the exposed neck, and white tails have been identified for various animals. What are the critical sign stimuli for the human that act to release stereotypical adaptive responses? What are the invariances of the cue functions in the human environment, not mediated by symbols, that help to release specific motor patterns built up through evolution by natural selection? The sordid history of man attests well to the fantastic plurality of stimuli that can be cooked up to elicit aggression. But how "natural" are they?

Like all animals, man has evolved biologically, but, unlike many animals, social adaptations were of supreme importance in his evolution. Selection operated not only on his aggressive tendencies but also on the rest of his social behavior. Man is capable of co-operation, empathy, sympathy, sacrifice, deferment of gratification, exceedingly strong bonds to others closely related to him, and extraordinary ties with numerous symbolic constructs involving religious, ideological, and material matters. In other words, man's evolution has involved a complex number of interacting variables, and we cannot hope to understand him or his evolution without reference to the social matrix involved in his adaptation.

Need for An Expanded Framework

Looking back at the definitions of aggression, we see that they are mainly drawn from works of a highly experimental bent. I think that our understanding of human aggression must encompass more than the laboratory demonstrations compatible or dependent upon the definitions given. This is hardly meant as a slight to the empirical studies of aggression undertaken by numerous psychologists, sociologists, or animal behaviorists. We need a theory of human aggression, and such efforts toward a theory will rely heavily on empirical studies that are able to delimit and vary external and internal variables in their study of human and non-human aggression. It is argued here, however, that we need a species-specific framework of aggression, and such a framework must integrate the aggressive components of man's behavior with the rest of his social, psychological, and biological matrix. Man is the only animal with language and an adaptation based on the sharing and use of arbitrary symbol systems. As Lenneberg (1967) has so well argued, the organization and development (ontogenesis) of his brain are unique or, to phrase it better, species-specific. His development and behavioral expression are species-specific too; also, man is in constant interaction with his peers, himself, a material world, symbol systems, strangers, and enemies.

Non-human animal studies suggest that almost all animals are capable of aggression, but there seems to be fair agreement that animal aggression is far from constant, and that the stimuli evoking aggressive responses are discrete and mostly limited to matters of sex and territory. There seem to be no animals who attack for attacking's sake, except when hunting for food, as in the felids, or when challenged by members of their own species for territory or mates, or by predatory species. As Lorenz and others have pointed out, most animals enjoy the possession of behavioral mechanisms that inhibit further attack or injury, for example, the wolf, which bares its neck to inhibit the onslaught of its opponent. Perhaps there are postures and vocalizations that have an inhibiting or appeasement function in man, such as the averting of eyes, cringing, tears, etc., but it is obvious that these need not offer any guarantees against further aggression or injury from an opponent. In the human case, moreover, the many stimuli that can evoke aggression are exceedingly varied and complex, and aggressive tendencies can last long beyond the emotional state of anger and can continue to occur even in the absence of the attitude of hostility.

The major framework in psychological thought regarding human aggression revolves about the "frustration-aggression" hypothesis offered by Dollard *et al.* in 1939. There is little doubt that frustration is a major stimulus for provoking aggressive responses, but it is debatable whether the original formulation that all aggression stems from frustration, or that aggression always follows frustration, is accurate (Berkowitz, 1962, 1966).

Several studies of primate behavior (DeVore, 1965; Schrier *et al.*, 1965) show that monkey and ape offspring are highly motivated toward play and contact with peers, adults, and inanimate objects, and are highly curious—observations that apply to man and other young mammals. Through play and mock combat, the young animals learn skills of social interaction and, eventually, their position in dominance terms relative to their peers. They enlarge their sphere of knowledge about their environments, and part of this enlargement is the outcome of aggressiveness. Also, behavior changes with maturation—the so-called critical periods of birds, sheep, dogs, etc., are familiar examples. In the human case, a child acquires different behavioral patterns as he passes from birth to adolescence. The language abilities, starting at about one to two years, are a good example of species-specific patterns of neural and behavioral development. These also require a peculiar human pattern of social and emotional nurturing for their healthy development. Associated, in part, with the specific neural events that accompany development, are patterns of psychological development that center about the construction of the child's ego, his moral sense, his reality picture and ability for concrete and abstract thought, his pleasure in controlling his body from proprioceptive impulses, and his aggressiveness. As definitions of the child change through a constantly interacting feedback process of his own development and the manner in which adults and other peers perceive and treat him, so do the demands made upon him change. It is in this area that frustrations are practically impossible to avoid—they are structured into the process.

Goodenough (1931), for example, found definite developmental patterns of expression and control of rage during the course of child maturation. In general, as the brain grows, so does the child's reality picture of the world, his expectations of the behavior of parents and peers, and his control of rage. In early stages, rage is sudden and explosive, but quick to subside and easily forgotten. With maturation, the thresholds for such expression rise, but once exceeded, the rage and anger are longer in duration and subsequent brooding or hostile periods are prolonged. These changes point to neural and ego variables, involving components of inhibition and facilitation, as well as an enlarged capacity for sustaining particular memories.

Other authors have studied children's aggression, and there seems to be wide agreement that aggression increases during the early years, reaches a peak, and then tapers off as social control factors and the child's realization of deferment of gratification by the environmental surround comes into effect. It is worth stressing what Schilder pointed out some time ago: many of the destructive elements of child play are natural concomitants of learning and are often accompanied by a constructive aftermath as well.

There is another aspect to human behavioral organization, particularly at the social structural level, that must enter into any framework of human aggression. The cohesion of human societies depends on mutual co-operation on economic tasks, and these require different degrees of role affiliations. A man often has three roles—father, husband, and worker. If the social structure has additional complexities, the roles proliferate, and the complexities and contingencies of each role enlarge. Roles depend on tasks, and roles place commitments and burdens upon people. The human animal, because of the social adaptation it undoubtedly gained through natural selection, is perhaps unique in that it has plural role responsibilities, each attended by symbolized, arbitrary codes for conduct. These provide a natural structure both for beneficial adaptation to varying difficult environments and for the production of frustrations.

As animals, humans are highly egoistic, emotional, and dependent. Their closest relative, the chimpanzee, evokes the greatest amount of empathy among human observers. Moods, personal attachments to objects and other peers, infants, dominant males, etc., are a common theme in the primate literature, and these emotional components seem particularly heightened as one approaches man. In other words, we have here what might be called a "sentiment structure," which figures in the species-specific patterns of human behavior, both socially and individually. The task is to define this structure, understand its components and their interactions, and place it in an evolutionary, adaptive framework. This is why our framework of human aggression must be enlarged; why we must reject any simplistic incantation of direct instincts.

It is largely through his sentiment structures that man is capable of frantic antics in response to diverse symbol clusters, is able to fan up and maintain associations, and can be manipulated by those who understand too well what man needs, and what frustrations are most capable of diminishing the individual's evaluation of himself. These considerations lead me to the formulation that human aggression is an outcome, in part, of natural selection for heightened sentiment structures, focused about self-identity and a co-operative social structure. To achieve his co-operative abilities, social structuring has required selection for greater degrees of affect, or emotion, interplay than in other animals. These are necessary for other-commitment, which develops through self-commitment. The structures, social and symbolic, that permit his adaptations and the execution of shared tasks to insure his existence, also insure frustration, pain, and group conflict. In short, groups mean conflict. Conflict is structured into existence by the very fact of group identifications. Aggression may be defined as the imposition of the self (either individual or group identity) on others (individual, group, object, abstraction).

Human Evolution and Aggression

It is impossible to do more than speculate about human origins and make educated guesses about the mechanics and dynamics of early human adaptations. But speculations might nevertheless lead to some critical thinking and dialogue about the nature of man and how he came to be.

It is convenient to start with what seem to be reasonable conclusions of some important variables involved in the early evolution of man.

1. An enlarged and more elaborate central nervous system, particularly the cerebral cortex, which grew from roughly 500 cc. 1.75 million years ago to roughly 1,500 cc. at the present.

2. A diminution in sexual dimorphism between male and female with respect to structures used ag-

gressively, such as canines; but an increase of dimorphism in terms of fat, muscular development, and shape. Possible increased dimorphism of behavior.

3. Full-time sexual receptivity of the female, and domestication of the male, or, if not actual domestication in early stages, a division of roles, with the male hunting and procuring high protein food sources.

4. An increased time of infant and child dependency, because of a prolonged growth period.

5. Some cognitive reorganization dependent upon expanded and reorganized brains, and a shift in the nature of social relations, resulting in toolmaking and the use of arbitrary symbols for language.

The evolution of man was not only comprised of an evolution of the body and individual behavior, but of the coadaptation of behavior, i.e., social structure. The evolution of such structure was essentially a strategy to engender co-operation for survival. Thus, one strategy would have been to select for those neurological and behavioral constellations that served to increase social, or "affiliative," desires. This could have occurred through concomitant selection for agencies (primarily perceptual and neural) that made inhibitions against intragroup aggression stronger. One such agency would have been an enlarged cortex capable of a more complex scanning of both material and social stimuli. Language also functions in social structuring. It is a device to describe and catalog or teach about environments; it is also a mechanism capable of heightening emotions, allaying ambiguities, and reducing distortions of perception.

The reader might wish to rebel at what has been stressed thus far—the emotionality sector over that of the more rational, intellectual attributes of bigger and better brains during human evolution. The relationship between bigger brains and increasingly adaptive behavior, in terms of appraising environmental complexity, learning, memory, etc., seems fairly straightforward. But the role of emotions—or better, arousal—is less well understood. Experimental evidence makes clear that there are optimal levels of arousal of the organism associated with the appreciation of cue complexity and task performance. This relationship is known as the "inverted U function" because there exists an optimal state of arousal, mediated through the reticular formation and possibly the limbic lobe, which facilitates intellective functioning. Too much or too little arousal results in a drop-off in perceiving cue complexity and task performance.

Surely, in the evolution of the human animal, natural selection did not militate against the ability to appreciate cue complexity (the many and ever increasing attributes of the physical and social environments) or task performance. The complexity and sophistication of stone tools during the Paleolithic (concomitant with brain size increase) attest to this. These reasons suggest that natural selection favored the development of a large cortex to handle environmental complexity and task efficiency, at the same time selecting for optimal arousal patterns. Such selection for arousal patterns very likely also meant selection that resulted in temperamental differences, thus adding another sector to the complexity of the social environment. If the adaptation of early man lay heavily in the social realm, as suggested here, increasing inhibitive controls would have been highly beneficial. In other words, not only was intellect enhanced but also the ability to get along in groups through positive affects, in part based on more optimal arousal mechanisms, which would also have been advantageous for such intellectual functions as task concentration.

Let us now examine intellectual functioning and the brain with respect to natural selection:

1. Selection for larger brains was also selection for an increase in the ability to *sustain* any ongoing activity requiring (a) concentration, (b) time lengthened at task, (c) inhibition of non-relevant cues (selective perception).

2. Such selection also meant selection for ability to perceive more complex cues or stimuli.

3. Such selection meant an increased memory storage potential, through more parts and more connections, plus some possible biochemical changes in terms of coding experience.

4. It seems likely that such selection also meant selection for co-operative abilities, requiring *facilitation* of attention, and *inhibition* of second-to-second monitoring of other actors' personal qualities, as found particularly developed in some of the most aggressive of the terrestrial primates, the baboons and macaques.

What is required of a brain to do all of these?

(a) Elaboration of arousal mechanisms to keep the cortex "tuned," involving the ascending reticular formation, thalamus, and cortex.

(b) Probable inhibition of lower centers, such as the hypothalamus and limbic lobe.

(c) Facilitation of memory by increased storage through more parts and connections; increased permanence of memories (possibly through chemical coding); increased facility of recall, mediated through increase of neural parts; and, a *symbol system* or *language*.

We can now ask a central question: would an increase in positive affects or sentiment structures help in any way to achieve intellective improvements through evolution? I suggest that the social nature of man and the social adaptations were facilitated by an increase in the emotional sector, associated with what has been loosely termed as sentiment structure, where these facilitated both the task of co-operative enterprises and the long-term care of the dependent child with its increasing brain growth.

But what of aggression, particularly human aggression? The hypothesis I offer here is as follows: *Human evolution has been the evolution of a paradox. The evolution of the brain and social structure, as well as symbol systems, has also meant an attending increase in frustration and aggression. The meaning of symbols in the adaptive evolutionary sense is at* *least twofold: they aid in cognitive optimization, and also, they mediate the social controls necessary to stem what arises out of the human condition—frustration and aggression. The same symbolism that enhances sentimental bonds between kinsmen and between symbolically defined groups outside of biological relationships (clan, tribe, state, nation, ideology), brings in its wake its antithesis: extra-group aggressional tendencies. Role differentiation and intragroup commitments generate frustration. Man is up against himself—he is up against social structure, he is up against culture. These are his costs as well as his gains. Each man is killed and deadened many times over in the course of his life.*

And what of warfare? Warfare at the level of mass societies cannot be explained by this framework or by recourse to individual psychology. This framework does provide a basis, however, for understanding how states can utilize the aggressive components of man's nature for their own ends, and how hostilities at all levels can be perpetuated through time. The framework does not explain revolutions either, but does provide a reference system for understanding the absolute necessity of providing all with a chance to realize their full human potential, including the important sector of self-valuation and opportunity for self-participation in any culture.

Yanomamö Social Organization and Warfare

by Napoleon A. Chagnon

Chronic warfare, and its associated ideals, permeates various aspects of Yanomamö culture. It may even be said that aggression is the theme of the Yanomamö way of life, the charter for which seems to lie in their myth about Moon. While studying these Indians in the humid tropical forest of southern Venezuela and adjacent portions of Brazil, I was repeatedly told how Moon, whom they call Peribo (in some cases, Periboriwä), had the habit of visiting earth to eat the souls (*noreshi*) of children between pieces of cassava bread. Two brothers, Uhudima and Suhirina, took offense at Peribo's activities and decided to shoot him with their arrows. Uhudima tried first. But he was the poorer shot of the two brothers, and missed. Then, when Peribo reached his zenith, Suhirina shot one bamboo-tipped arrow into his abdomen, causing him to bleed profusely. Peribo's blood spilled to earth and immediately changed into the first men (Yanomamö). *It is because man came from the blood of Peribo that he is inherently fierce and wages constant war.* Such is the explanation given by the Yanomamö.

There are about 10,000 of these Indians. Their villages, between 100 to 125 in number, contain from 40 to 250 inhabitants and are scattered widely over the immense tribal territory. Sustained contact with this tribe began in 1950 when a member of the New Tribes Mission located, and moved into, one of their villages on the Orinoco River. However, most of the Yanomamö contact with outsiders has occurred since 1958. Even now, many of their villages have never had outside visitors, although most probably have acquired steel tools via the Yanomamö trading networks.

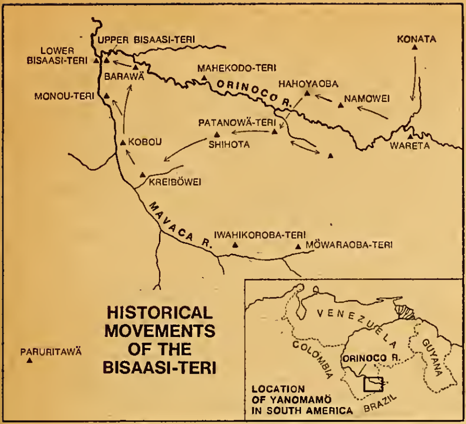
The culture of these Indians is surprisingly uniform from one end of their territory to the other, except for variations that exist in details of mythology, language, and material culture. Although the sixteen months I spent in direct contact with the Yanomamö were largely confined to the Mavaca-Orinoco drainage areas, I did visit all the dialect areas with the exception of the southern area, some members of which I met on the Mucajai River. So, while my generalizations are probably valid throughout, they can apply specifically only to the central and western dialect areas until the projected further field work is done.

Furthermore, the generalization about aggressiveness has a specific limitation. Only fierce men came from blood. The Yanomamö turn to another origin myth to explain the creation of cowards and women. In this myth the legs of one of the first beings, Kanaboroma, became pregnant. One of the legs generated women. The other leg generated cowards. In such fashion the Yanomamö can explain or justify mythologically why most of them are fierce, and why some prefer to run rather than fight.

The Yanomamö place a high value on bellicose behavior; all men are obliged to demonstrate their capacity to behave fiercely. This usually takes the form of the stronger pushing the weaker around: threats, intimidation, shouting, chicanery, duels with fists or clubs, and, frequently, just bluffing. Many, however, display their ferocity in the relatively harmless (at least to them) beatings that they administer to their hapless wives. This punishment is for real wrongs or imagined ones, such as a slow response to a command or being too sassy. More severe punishment is meted out if the woman has been caught in the act of having an affair or sometimes if the husband merely suspects that the wife has had an affair. One man hit his wife in the mouth with a glowing brand of firewood, another cut his wife's ears off with a machete, two men shot their wives with barbed arrows, and so it goes. The Yanomamö consider it quite appropriate to display their ferocity by venting anger on their defenseless wives, the implication being that they will be equally fierce with male competitors. Younger men admire their married superiors for beating women, even flock to them and bask in the aura of renown.

The propensity to display ferocity (*waiteri*) begins early in the socialization process. Young boys are encouraged to strike their elders, then are rewarded for doing so with approving laughter by their parents. A

Napoleon A. Chagnon is an assistant professor at the University of Michigan Medical School, where he continues his research on the Orinoco River tribes of Venezuela and Brazil.



HISTORICAL MOVEMENTS OF THE BISAASI-TERI

child, only four years old, has already learned that the first outlet for his displeasure should be to strike his father—or any one else immediately available—in the face. Everybody, including the target, praises him for his *waiteri*.

Yanomamö treat their sons with great indulgence because males are considered to be superior and more desirable than females: they will grow up to be fierce warriors and defenders of the group. Men prefer to have a son for their first child, and should the wife deliver a daughter, the new baby is often killed at birth. The Yanomamö also kill male infants, but only if the mother already has a nursing child. They believe that if this child has survived the hazards of neonatal life, of which there are many, his further chances for survival should not be jeopardized by obliging him to compete for milk with a new sibling. The net result of the infanticide practices is that there are more males than females in the population. (In some villages the sex ratio may show a 30 per cent excess of males.) Inasmuch as successful, fierce men usually have two or more wives, the consequence is that some men will be forced into prolonged bachelorhood. This gives rise to keen competition among men for the available women, imposing pressure on all the competitors to behave aggressively in the pursuit of mates. Yet another factor complicates the demographic situation. The Yanomamö prohibit coitus with a pregnant woman or a woman who is nursing a child. This situation is aggravated by the fact that women nurse children for three years or so. The Yanomamö, therefore, quite understandably do not hold rigorously to the taboo on lactation coitus. Nevertheless, men with several pregnant or lactating wives are usually no more gratified sexually than ordinary bachelors, and like the latter, such married men tryst with the wives of covillagers. This results in bloody club fights.

Thus, in the interest of raising warriors who will make the group invincible against enemies, the Yanomamö get themselves into a demographic situation that leads to even more aggression, a sort of social pathology for which the cure is more of the same.

An essentially unstable village life is one of the consequences of this syndrome of competition for females in an arena where aggression and ferocity is the surest way to success. In small villages containing, say, 40 people, the situation is not nearly so volatile; kinship roles and incest taboos are capable of regulating personal behavior more or less smoothly. But as villages grow in size they become more heterogeneous in their composition. Accordingly, they include more women of the appropriate kinship category available for sexual liaisons. This makes sexual affairs more common, which, in turn, makes club fights relatively frequent in larger villages. The fighting becomes so chronic that a larger village fissions into smaller groups after reaching a size of about 100 to 150 people. If the village is actively engaged in wars, the threat from enemies may inhibit the fissioning for a while, but it cannot prevent it altogether.

The attitudes and values associated with ferocity also carry over into the intervillage political realm. Here it is considered part of policy to bully and coerce weaker neighbors so that they will provide women. Small villages are obliged to enter into military alliances with neighbors for purposes of defense, but the principals in an alliance can never trust each other. The allies confront each other with the hope of remaining at peace but meanwhile are intent on gaining the upper hand in the marriage exchanges that will take place between them to cement the alliance. Hence, each is obliged to demonstrate to the other that it is fierce and capable of maintaining its sovereignty. This explains why feasts between allies frequently end in prearranged duels, for in such fashion the groups can generate some solidarity by sharing food while also displaying their respective capacities for defending themselves.

In this connection, each village has an informal group of men who are considered to be the *waiteri*. These "fierce ones" dictate policies of the village in regard to raids on other groups; the younger, less influential men are then required to follow through and execute these policies, reluctant though some of them may be. In terms of a village's capacity to conduct war successfully, the more fierce ones it contains, the better it can defend its sovereignty. For example, a village was forced to abandon its garden and migrate to a new area because "all the fierce ones were killed by the enemies" and nobody else in the community was capable or interested enough to prosecute the war against these enemies.

Each village, in addition, has at least one recognized leader, or "big man" *(pata dodihiwä)*. His position is determined, in part, by the size of his kinship group and by his military achievements and demonstrations of ferocity in fighting. Some villages have two such headmen, arising from the two dominant political groups that are bound to each other by marriage ties extending over several generations.

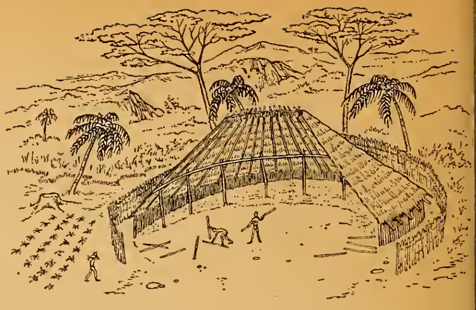
The headman has another function. He is the most influential man in his kinship group and, accordingly, has much to say about how its women are disposed of in marriage. Most headmen are brilliant politicians in this regard. With gain in mind, they give their sisters and daughters—or withhold them. Hence, marriage in Yanomamö society, which can be considered to be the disposition of scarce and valuable resources, is at once an economic and a political phenomenon. Yanomamö social organization in fact can largely be considered to be the structural patterns resulting from marriage-exchange practices.

Before discussing these patterns let us see how concepts of aggression permeate still other aspects of Yanomamö culture. To begin with, there is the Yanomamö concept of the cosmos. It has four layers, of which the first is "the empty layer." Man (again remember that Yanomamö were the first people created) lives on the third layer, which itself originated when a piece of *hedu,* the place of the souls of dead men (layer 2) fell down. More recently, another piece of *hedu* broke off and fell to earth (layer 3), where it struck the village of Amahiri-teri and kept on going, carrying the village down to layer 4. The people of Amahiri-teri have no meat because their part of the jungle and the game it included was not carried down with them. They must therefore rely on eating the souls of men on the earth layer. This is why a constant struggle is waged between men on earth and the spirits sent by the people of Amahiri-teri.

In addition, supernatural struggle is conducted right on earth among enemy villages. Each has shamans who control and manipulate a number of small demons (*hekura*). These are sent against enemies to eat the souls of children and thereby weaken the enemy by causing death in his village.

The Yanomamö also believe that each individual has an animal counterpart, an alter ego, that lives in some distant part of the jungle. The mutual lives are coextensive and coterminous—when either the man or the animal dies, the corresponding partner also dies. Thus, when Yanomamö hunt and kill certain animals they are also killing their enemies, for some of the animals killed surely correspond to an enemy in some distant village.

Despite all the pressures on men to behave fiercely, many men, particularly the younger ones, are frightened and reluctant to participate in raids. But their fierce elders intimidate them into participating, for a group that refuses to defend itself soon earns the reputation of being timid and will fall prey to the incessant demands of its stronger neighbors for women. I accompanied one raiding party partway to its destination. Several of the young men wanted to turn back before we were an hour away from the village, allegedly because they had sore feet or malaria. The leader of the raid gave them a stern lecture on cowardice, which brought them back into line. But the leader himself, a man of some 35 years, had also been reluctant to go on the raid. He was obliged to do so, however, by the entire system of pressures from his allies, some of whom had recently begun demanding women from his group because it appeared to fear its enemies. In the interests of the village, he had to raid the members of a village that had recently killed his brother, not so much for personal revenge, but because his group was acquiring the reputation of being cowardly and unwilling to defend itself.


Typical village bordered by food-growing garden.

Yanomamö society is, so to speak, embedded in the kinship system and its attendant practices associated with obtaining wives. By means of the kinship system one's role in society is fixed by the particular kinship role he plays with respect to all others around him. The kinship term emphasizes the person's social role—a Yanomamö uses the same term for his father and his father's brother; his mother and mother's sister are also merged into a single category. This system and its taboos are carried so far that among the six primary kinship categories to which a female can belong, a man is obliged by marriage rules and incest prohibitions to marry into only one category. This is called a prescriptive marriage requirement, and permits anthropologists to make a definitive model of the entire social structure. The category that meets this particular requirement corresponds to our notions of cross-cousins (cross-cousins are father's sister's children and mother's brother's children). Yanomamö men call their female cross-cousins *suaböya* and are obliged to marry a woman who is *suaböya.*

One of the cardinal features of the Yanomamö marriage system is that a group must give a woman back to the group that earlier provided it with one. For a tribe of Indians whose language contains only the numbers *1, 2,* and *more-than-2,* the Yanomamö keep extremely sharp books on marriage exchanges. For example, three villages have six major lineages. Over several generations of marriages these six lineages exchanged 181 women. One lineage gave 74 women and received 79; another gave 61 and got 60 back.

Now let us move to the crux of our discussion, the effect of warfare on Yanomamö social structure. Marriage, of course, is one of the most important components in determining primitive social structure. Consequently, to understand the effects of warfare we must examine the historical relationships among villages that are currently exchanging women in marriage. We will begin with a group of people now known as the Bisaasi-teri (among Yanomamö, the group and its village take their name from the "garden" that surrounds the village).

Before the turn of the century, members of this group of Indians were located north of the Orinoco River at a site called Konata; therefore they were then the Konata-teri. They were driven from their village by a cluster of villages to their north, and had to take refuge with an ally at the site called Wareta. They left Wareta about 1910 because their hosts were demanding women from them in return for protection, and because their hosts had gotten into war with villages to the east. Their new home, Namowei, was occupied only about 10 years: a new war with their old enemies forced them to abandon this site and settle at Hahoyaoba, about 1920. The soil here was poor, so they moved across the Orinoco to Patanowä about 1925. By now, however, the group had grown so large that internal fighting was frequent, mostly over sexual affairs. Patanowä fissioned and the two resulting villages ultimately began fighting each other. The trouble grew so intense that one of the groups of Patanowä-teri fled to Shihota about 1943. But the fighting continued, so the occupants of Shihota fled to Kreiböwei, about 1949. Here, they entered into friendly contact with the village of Iwahikoroba-teri and began cultivating an alliance with them. But these people were already allied to the Möwaraoba-teri, mortal enemies to the people of Kreiböwei.

A feast was arranged for the latter at Iwahikoroba-teri in 1950. Actually, it was an ambush and massacre. Fifteen men were treacherously murdered by the hosts and the hosts' allies, and Kreiböwei women were abducted. The survivors took refuge in the occupied village of Mahekodo-teri, on the Orinoco. From here they raided their treacherous enemies and worked at clearing a new garden, Kobou. They moved to the latter garden as quickly as possible, because their protectors, the Mahekodo-teri, were suspected of plotting a second massacre—a rumor that later received some substantiation. Kobou was just a temporary site from which the more suitable locations of Monou and Barawä could be colonized; these were too far away to reach in a single, long move. The group split in the process of abandoning Kobou, again the result of numerous internal fights over women. The site of Monou is presently occupied by the Monou-teri; Barawä was abandoned about 1959, when foreigners, who possessed steel tools that the Barawä-teri wanted, arrived at the mouth of the Mavaca River to set up a malaria control station.

After abandoning Barawä, its Indians split into two groups, each locating on opposite sides of the Mavaca River. These are the Bisaasi-teri; they are now on good terms with each other and have not yet become independent villages.

Meanwhile, the Bisaasi-teri and Monou-teri allied themselves in 1960 with the Paruritawä-teri in order to get revenge on the Möwaraoba-teri for their treachery in 1950. The Paruritawä-teri were related to the culprits but were not on intimate terms with them. They managed to persuade some of the Möwaraoba-teri to come to a feast in 1960. Those who came were summarily murdered by the combination of the Monou-, Bisaasi- and Paruritawä-teri, and the women were captured. The Paruritawä-teri were themselves racked by internal fights over women, so they fissioned into two villages. But geographically and logistically, these two villages were at a disadvantage—they were at the receiving end of most of the revenge raids for their complicity in the 1960 treacherous feast and had to rely heavily on the military support of their new allies, the Bisaasi-teri and Monou-teri. The latter two groups used their political advantage wisely and coerced them out of women. The net result is that a relatively stable alliance pattern has emerged, linking all four of the villages that conducted the second treacherous feast. However, this alliance shows a temporary imbalance in the reciprocity of women. It favors the politically and militarily dominant pair, Bisaasi-teri and Monou-teri.

The significance of the relation between warfare and the resulting politics of alliance formation based on women exchanges can be seen in the accompanying table, which compares marriage types and frequencies in two of the villages just discussed. The term *prescriptive* refers to *suaböya* types of marriage. *Incestuous* marriages involve men who are related to their wives in some way other than *suaböya*. *Alliance/abduction* marriages lump together cases of marriage between a man and a woman who came from a different village; in Patanowä-teri, these are mostly abductions while in Lower Bisaasi-teri they are prearranged transfers that use women to stabilize alliances. Finally, the three "unexplained" marriages are those involving individuals whose descent groups have only recently entered into protracted exchanges and where the spouses do not yet stand, genealogically speaking, in a suitable marriageable relationship. The Yanomamö would, however, consider them as legitimate marriages of the prescriptive type.

MARRIAGE TYPES IN TWO RELATED VILLAGES

	Patanowä-teri	*Lower Bisaasi-teri*
Prescriptive	37	7
Incestuous	4	1
Alliance/Abduction	8	9
Unexplained	3	0

It is immediately apparent that the marriage practices in the two villages differ significantly from each other. The reason that the Patanowä-teri have managed to marry more in line with the rules is because their village, having more than 200 people, does not have to establish military alliances based on intervillage marriage exchanges. It is militarily a sovereign group. Lower Bisaasi-teri, on the other hand, contains only 51 people. Obliged to make alliances with its neighbors, it has to tolerate some disregard of the marriage rules.

This shows that the military vulnerability of small villages and the existence of chronic warfare alter the frequency of certain types of marriages in Yanomamö society. To the general reader this might mean no more than a decrease in "inbreeding." But to students of social anthropology there are a number of interesting theoretical consequences.

One school of thought, for example, maintains that a marriage alliance system can be called *prescriptive* only if men are obliged to marry a woman of a specific, single category. I have presented this point of view. The changes in relative frequency of marriage types brought about by the defense needs would not be considered as producing a change in the *kind* of social system itself. The villages concerned would still exemplify a prescriptive system of marriage alliance because neither the marriage rule nor the kinship pattern has changed. The statistics on marriage types would be considered to show only some interesting functional relationships between marriage and warfare.

An alternative school of thought maintains that a society may be characterized as having a prescriptive marriage alliance pattern only when a high proportion of the marriages, close to 100 per cent, follow the marriage rule. Data in the table would mean, in this view, that two genetically related villages of the same tribe have different *kinds* of social systems since frequency of marriage type is used to distinguish one kind of system from another. This is a logical, but perhaps absurd, conclusion to draw from the above data, given that statistical runs are all important in determining types of social structures.

It can be seen that warfare affects Yanomamö society in multiple ways. As with the Plains Indian societies of the American West, the social organization and many other aspects of the culture reflect the total commitment of the society to the warfare motif. This commitment is expressed in individual attitudes, and its effect on social structure, in the evolution of primitive societies to modern ones, has probably been great.

Hypotheses About Functions of War

by Andrew P. Vayda

In analyzing the functions that war may have, we are trying to show the systemic antecedents and consequences of organized armed conflict. More specifically, analyzing the possible functions of war involves us in considering hypotheses that propose that war constitutes a counteracting response made by a system when a variable or activity within the system has been disturbed from its proper, desired, or acceptable state. In other words, the "function" attributed to war in these hypotheses is the maintaining of one or more variables or activities in a certain state or within a certain range of states.

That war should have functions at all is, of course, in itself a hypothesis, and alternative hypotheses, for example, that war is a non-functional pathological condition of society, have often been presented. One reason to examine the particular hypothesized functions of primitive war is to help provide a basis for assessing the more general hypotheses about whether war is, in some significant way, functional. Such an examination may also have practical implications for the prevention of war. If we should indeed find that war constitutes a counteracting response made by a system when a variable within the system has been disturbed, we can then try to prevent war either by seeking to eliminate the disturbances whereby the variables are moved from their proper, desired, or acceptable state or by looking for alternatives to war as a counteracting response to the disturbances.

My primary focus in this article will be on the functions of "primitive war"—organized armed conflict between members of the relatively small, stateless societies traditionally studied by anthropologists.

Functions of primitive war. Hypotheses presented by various writers are concerned with the functions of primitive war in maintaining or regulating certain economic variables. According to these hypotheses, war breaks out between groups when the inequalities in their possession of, or access to, certain economic goods or resources reach a certain magnitude. Such hypotheses are "functional" ones if they go on to state that the effect of the warfare is to reduce the inequalities to an acceptable level. Examples are hypotheses that say that the distribution of camels among Bedouins and of horses among Plains Indians is regulated when groups with too many animals become the victims of stock-raiding by enemy warriors (Sweet, 1965a, 1965b; Vayda, Leeds, and Smith, 1961). With respect to certain primitive people who are not pastoralists, similar hypotheses have been presented, but with land, rather than camels or horses, as the redistributed resource. Meggitt (1962, 1965) offered such a hypothesis with reference to the Mae Enga, a horticultural people of the New Guinea highlands, while I have offered it as applying to the warfare of various primitive people who have in common the practice of swidden, or slash-and-burn, agriculture (Vayda, 1961).

Similar to these hypotheses relating to economic variables are certain hypotheses about the regulation of demographic variables. In these, the "resources" that are redistributed as a result of warfare are humans, especially in some cases, those belonging to some particular age or sex category. Autonomous local groups are small enough in much of the primitive world to be subject to considerable fluctuations in size, sex ratio, and age distribution as a result of chance variations in natality and mortality. The taking of war captives is one possible means of counter-

Andrew P. Vayda is an associate professor at Columbia. Much of his article is taken from his earlier paper "Research on the Functions of Primitive War," Peace Research Society (International) Papers.

acting the imbalances resulting from such chance variations, and the capture of women in particular is mentioned in the traditional accounts of primitive warfare in various parts of the world (Davie, 1929).

The redistribution of land as a result of primitive war can, of course, equally be seen as a redistribution of people upon the land—a victorious group's movement into a vanquished and dispossessed enemy's former territory. Should there be no place to which the vanquished can flee, the answer to problems of local population pressure may, it has been suggested, be heavy battle mortality rather than simply dispersal or redistribution. This familiar Malthusian hypothesis, attributing to war the function of reducing population pressure through effects on mortality, receives some support from accounts of primitive warfare in such regions as New Guinea. I know of one New Guinea local group of some 300 people that was literally decimated in a single campaign, and there are other reports of entire village communities, both in New Guinea and elsewhere, that were exterminated in fighting (Bureau, 1959; Krzywicki, 1934).

Another hypothesis in the study of primitive war is one of deterrence, or "preventive war": warfare undertaken by a group to avenge insult, theft, nonpayment of bride-price, abduction, rape, poaching, trespass, wounding, killing, or some other offense committed against its members deters members of other groups from committing further offenses. Putting it in more explicitly functional terms, we can say that when some such variable as the number, frequency, or magnitude of the offenses committed against a group exceeds a certain value, then the group goes to war, and thereafter, at least temporarily, the number, frequency, or magnitude of offenses committed declines. The hypothesis focuses attention on what has been called "fighting for revenge" among primitive societies. The reports on numerous societies of swidden agriculturists in various parts of the world (see references, Vayda, 1960), and even on some of the simplest societies of hunters and gatherers (Hobhouse, 1956), often emphasize the role of fighting in helping to satisfy aggrieved peoples' desire for revenge. However, the possibility of deterrence—the part that the fighting may play in maintaining the integrity of groups and their possessions—clearly needs also to be considered.

Hypotheses about functions of primitive war in regulating psychological variables have often been presented. The notion that primitive war may operate to keep such variables as anxiety, tension, and hostility from exceeding certain limits is implicit in the statements of anthropologists who speak of primitive wars as "flight from grief" devices (Turney-High, 1949), as "enabling a people to give expression to anger caused by a disturbance of the internal harmony" (Wedgwood, 1930), and as serving to divert intrasocietal hostility onto substitute objects (Murphy, 1957, citing Coser, 1956). Some support for such generalizations is provided by native informants' descriptions of the antecedents of wars in which they or their ancestors have been involved. A good example is an account given to Whiting (1944) by one of his informants in the Sepik District of New Guinea. The man said he had organized a raid because his wife had made his "belly hot with anger" by taunting him. Whiting presents this as an illustration of aggression being generated within a group and then finding an outlet against another group. I obtained a number of similar accounts in 1963 in the course of field work among the Maring-speakers of the Bismarck Mountains in Australian New Guinea (Vayda, 1967).

So far, I have, for the most part, presented each hypothesis as being concerned with the regulation of a single variable. It should, however, be noted that there also are hypotheses concerning the relation between functions in the regulation of one variable and functions in the regulation of another. Thus, a more elaborate hypothesis than those previously given would be the following: (1) a diminishing per capita food supply and increasing intragroup competition for resources generate intense domestic frustrations and other in-group tensions; (2) when these tensions reach a certain level, release is sought in warfare with an enemy group; (3) a result of the warfare is reduction of the pressure of people upon the land, either because of heavy battle mortality or because of the victorious group's taking its defeated and dispersed enemy's territory; (4) the reduced pressure on the land means that the diminution of per capita food supply and the increase of intragroup competition over resources are arrested, and that domestic frustrations and other in-group tensions can be kept within tolerable limits. According to this hypothesis, psychological, demographic, and economic variables are all being regulated, with the regulation of one variable being dependent upon the regulation of another.

Comparisons with civilized war. Most of the foregoing hypotheses have often been stated (even if not proved) with respect to warfare among state-organized societies also. This is so, for example, in the case of the hypotheses about functions of war in the regulation of population size, population dispersion, intersocietal offenses, tension or aggressiveness, and inequalities in goods or resources. It should be noted, however, that some hypotheses about primitive war have a prima facie inapplicability in the study of civilized war. A case in point is the function of regulating the sex ratio. We would not expect this to be significant in civilized warfare, for we know that when numerous people are settled over an extensive territory under a single government, adjustments of any local demographic imbalances can be handled within the larger sociopolitical unit through movements of people. Reciprocally, some possible functions of civilized war are hardly to be expected in the warfare of primitive societies. Thus, any functions dependent on the subjugation and subsequent economic exploitation of enemy populations cannot obtain in the truly primitive world where neither food production nor political mechanisms are sufficiently developed for the support and control of economically exploitable classes of laborers or slaves (Hobhouse, Wheeler, and Ginsberg, 1915; Nieboer, 1900). Similarly, the frequently encountered hypothesis that attributes to civil or intrasocietal war some functions in checking or stopping abuses of political power cannot apply to primitive societies in which no persons or groups are sufficiently strong to significantly abuse power. It is true that intrasocietal wars in Polynesian chieftaincies prior to European discovery (Sahlins, 1963) and in African kingdoms (Beattie, 1959; Gluckman, 1963; Worsley, 1961) may have functioned to check abuses of power, but these societies, with their elaborate hierarchies of authority, are not truly primitive in terms of political criteria, even if the trait of writing, sometimes regarded as the diagnostic of civilized status, was not part of their cultures.

Tests of the hypotheses. Two things need to be emphasized: first, we have been describing hypothesized, and not necessarily empirically validated, functions of war, either in general or as practiced by particular societies; second, there is nevertheless a possibility of empirically testing the hypotheses.

Adequate tests would require much more extensive data than have hitherto been employed. At the least, we would need more and better data on the pre- and post-war values of the variables that are, according to the hypotheses noted, being regulated.

Some of the needed data on primitive war would be difficult to obtain. For example, to test the hypotheses about the regulation of psychological variables, it would be useful to have motor and projective tests and measures of hormonal levels, galvanic skin response, and the like applied to primitive warriors before and after fighting—but I know of no practical way of making such tests and measurements. Moreover, the procedure of seeking support for the hypotheses by using data on the rise and fall of suicide rates or similar variables that may be regarded as indexes of psychological disturbance or tension has little utility in studying primitive societies. Such a procedure can work to some extent when, as in the case of French society (Faris, 1955), quantitative data on the pertinent variables are available from a large population for more than a century, but the data obtainable from small, primitive societies without written records can hardly be expected to be statistically adequate.

Nevertheless, useful data may still be obtained to test some of the hypotheses about the functions of primitive war, particularly those hypotheses that deal with the regulation of economic, demographic, and sociopolitical variables. Thus, native informants in New Guinea, the Amazon, and similar regions where, until recently, primitive warfare was being practiced can still provide not only war histories but also the following: accounts of recent boundary changes or other land transfers; accounts of births and deaths in a group and of migrations into or out of it; and accounts of all the offenses committed by particular groups against one another during at least the last forty or fifty years. Furthermore, the ecological investigations necessary for defining pressure upon the land may still be undertaken in these regions. In the continuing work of a number of us in New Guinea, we are doing what we can to obtain such data, and it is to be hoped that field workers in other regions will make similar efforts before all the informants with memories of the relevant events have died.

Psychological Preparations for War

by Anthony F. C. Wallace

War is the sanctioned use of lethal weapons by members of one society against members of another. It is carried out by trained persons working in teams that are directed by a separate policy-making group and supported in various ways by the non-combatant population. Generally, but not necessarily, war is reciprocal. There are few, if any, societies that have not engaged in at least one war in the course of their known history, and some have been known to wage wars continuously for generations at a stretch.

Because war is apparently perverse, being both painful and sought after, people frequently give psychological explanations for it. Those who think about it with resignation, or with favor, conclude that making war is part of human nature, like making love; others are equally convinced that nothing so evil can be explained except as the result of social or psychopathology. In this discussion, however, we shall not be concerned to answer the ultimate question, but a more limited one: What, if any, psychological preparation is required for a society to enter *a* war?

The State of Mobilization

The principal psychological preparation for war is the training of all members of the society to participate efficiently in a social process that I shall call mobilization. I do not refer here simply to military mobilization in the modern sense of calling up reservists and drafting hitherto uncommitted men and resources to a war, although that is one instance of the larger phenomenon. Rather, I refer to the fact that all human societies, and the societies of many of the higher primates below man, are observed to exist alternately in two states. In one of these, lone individuals and a variety of subgroups occupy themselves in resting and in diversified and complexly co-ordinated economic, sexual, educational, and other activities. In the other state, the population arranges itself precisely into three well-defined groups—the policy-

Anthony F. C. Wallace is Chairman of the Anthropology Department at the University of Pennsylvania. His "Religion: An Anthropological View" has recently been published by Random House.

makers, the young males, and the females and children—and the entire society co-ordinates its activities under the leadership of recognized authority toward the achievement of a single task. The former state I shall call the relaxed state; the latter, the mobilized state; and mobilization is the process of transformation from the relaxed to the mobilized state.

Among the lower primates, the baboon troops described by DeVore, Washburn (1963), and others are the most obvious example of this alternation of states. In the relaxed state, the troop is dispersed: an aggregate of individuals and small groups engaged in feeding, grooming, sleeping, sex, and play. In the mobilized state—which is assumed while the troop is traveling—there is an exact partition of the troop into three groups, which occupy different and traditional positions in the line of march: the lesser males are at the front and rear, where they can confront challenges from predators; the dominant males and females carrying infants are in the center; and the other females and juveniles surround the central group. Similar formal traveling, hunting, and defensive dispositions have been described for a number of other social species. The capacity to mobilize is a widespread feature of animal behavior.

In man, the mobilized state, and its contrast to the relaxed state, has also been described in detail for many societies, although the large size and complexity of human groups often obscure the generality of the distinction. Gearing (1958) clearly conceptualized the difference in Cherokee culture between what he called the structural pose of peace and the structural pose of war and described the institutional arrangements associated with each. These two structural poses for peace and war, in similar institutional form, are assumed by a number of North American Indian tribes. One thinks also of the elegant and rigid arrangements of camp circle and police developed by the Plains Indians when they were hunting buffalo. In band and tribal societies generally, travel, hunting, and war require the state of mobilization. But in modern societies, characterized by urbanism, the nation-state, and complex and powerful technology, the alternation between the relaxed state and the mobilized state in matters of transportation, food getting, civil defense, and so on must proceed on different schedules for different institutions and localities. The whole nation still mobilizes only for a revitalization movement (a movement whose aim is to reform and reinvigorate a culture) and for war.

The Process of Mobilization

In order for a society to shift from the relaxed to the mobilized state, the population must receive a releasing stimulus, in response to which everyone promptly disposes himself according to a plan. Obviously the stimulus must be broadcast in order that all members of the population receive it quickly, correctly, and simultaneously. For a small band, most of whose members are always within earshot of one another, this is relatively easy. But the larger the group, the more difficult it is to prevent the communication from being distorted in transmission, from reaching individuals at different times, and from being seriously delayed in reaching some. Hence, as a society increases in size and as its territorial boundaries enlarge, cultural innovations are required that will ensure speed and reliability in communication of the releasing stimulus and any associated instructions. This requirement has probably prompted many tribal and early urban societies to invent special language codes, systems of graphic symbols, broadcast devices, and roads and other transportation methods, and to train men in the arts of precise memorization of messages and of rapid and careful travel.

It is also obviously desirable, although not necessary, that the releasing stimulus not merely elicit a disciplined response but evoke a motivational system appropriate to the action to be taken. Here the society enters into a kind of conspiracy with itself to combine the alerting signal with symbolic content that, given a certain distribution of modal personality variables, will arouse maximum desirable emotion. The releasing stimulus is therefore apt to be—particularly in the case of mobilization for war—a report that a certain kind of event has occurred to which people with that character type will respond with anger, determination, fear, or whatever affective state is desired by the communicating group. For Iroquois Indians, this symbolically arousing stimulus was always a report that a kinsman had been killed and that a survivor demanded revenge. For twentieth-century Americans, the symbolically arousing stimulus is apt to be the report that helpless Americans or their allies are being held prisoner or are under attack, and must be rescued.

It is important to note, however, that this embellishment of the releasing stimulus is not, and cannot be, necessary to ensure mobilization. A population is composed of persons with a variety of character structures and personal motives, many with limited intelligence and others suffering from greater or lesser degrees of psychopathology, and mobilization must proceed independent of private motive. Hence, atrocity stories, scare reports, and the like are never adequate to ensure mobilization; indeed, in some situations, such as medical emergencies, they appear to interfere with it. Thus the intensity of the emotion aroused must not be so high as to preoccupy the person being mobilized; the symbol must function more as a rationalization for personal sacrifice than as a stimulus toward unrestrained violence or flight.

Training for Mobilization

It is apparent that the shift from the relaxed to the mobilized state must be taken by people who have already learned what to do in response to the releasing stimulus. In all societies this learning probably occurs very early in life, and very largely without didactic instruction, in the course of the child's living through the alternating states of relaxation and mobilization. He learns, while acquiring the language, and by constant observation and participation, the difference between the two states and the nature of the three main status groups characteristic of the mobilized state. And as he grows older, he is trained more and more explicitly to recognize the releasing stimulus, to take orders, and to play specific roles in one of the groups.

One critically necessary feature of this learning is the development of a readiness to move from a situation characterized by considerable personal freedom and democratic, consensual decision making to a hierarchical and authoritarian structural pose. In many band and tribal cultures there is little in the way of coercive authority exercised in the making of decisions during the relaxed state but a very high degree of it in states of mobilization. Thus, among the Iroquois daily life in the village was largely managed by tradition, supplemented by consensual decision when alternative policies had to be chosen, and children were generally given a great deal of freedom. The Iroquois were famous, at least among European observers, for their intolerance of personal constraint. But when a war party mobilized, the participants suddenly assumed a posture of rigorous discipline under the command of a captain who had unquestioned and absolute authority during the military mission. At the end of the expedition, however, this authority terminated, and the captain's influence after that depended entirely on the willingness of other citizens to take his advice in council.

How the early Iroquois trained their children to be able to switch structural pose is not clear from the records available to us now. But a great deal of information is at hand to reveal how our own children are trained to switch poses. A classic example is the school fire drill, which, in addition to improving the chances of evacuating a school quickly in case of fire, provides a general model of how to mobilize in an emergency. At the sound of the alarm, the physical disposition and social relationships of the children abruptly change from the relaxed order characteristic of class or play group to the exact discipline of the fire drill line of march. Similar training in mobilization is given in athletic activities and in popular literature and film, where the training takes the form of play and spectator sport. The principle that is communicated in such exercises, apart from their specific utility, is that when the mobilization signal is heard, automatic obedience to recognized authority is required and assumes priority over other motives.

The Impersonality of War

So far, we have discussed the phenomenon of mobilization as the central theme in psychological preparation for war. But what of the fear, suspicion, and hatred of "the enemy," traditionally believed to be prerequisites for war, that are often invoked by the releasing signal? It is my contention that far from being necessary, these attitudes are almost irrelevant to war except as rationalizations. Human beings generally reserve their settled fears, suspicions, and hatreds for those closest to them: kinsmen, neighbors, and colleagues. Today's enemy in war is yesterday's stranger and tomorrow's ally. The psychological target of lethal weapons in war is an abstraction rather than a person (as the saying goes, "I have nothing against you personally"); hence any member of a society that at the moment happens to be classified as an enemy is apt, in one way or another, to be fair game (with "no hard feelings," of course). Few soldiers ever personally kill anybody; those who kill often do not actually see what they hit; and most never push a button, pull a trigger, or throw a grenade in combat.

War is never really total; its aim is never the absolute annihilation of the enemy and all his works; death and destruction are limited by more or less arbitrary restraints concerning the weapons to be used, the treatment of prisoners, civilians, and non-military targets, and the goals of military action. Thus, being removed from hate, war is also relatively free of guilt. This is not to say that some persons may not displace domestic hate upon foreign enemies by psychiatrically familiar mechanisms of defense, nor that bereaved persons, or those who have suffered personal threat or injury, do not experience, at least for a time, a very personal hatred. But such feelings are not a reliable indicator of efficiency in combat, where an ability to maintain cognitive orientation and a commitment to task-completion in noisy, fatiguing, and dangerous surroundings may be much more important than a high level of primitive urges to fight-or-flight.

Nor can war usefully be regarded as essentially an outgrowth of mass hysteria or mass movements, although some wars, and some events in most wars, are affected by such contagious enthusiasms. A religiously dedicated population, for instance, is likely to be easy to mobilize and difficult to defeat. But the action of a mob in sacking a building or in lynching a neighbor is almost the opposite of war, for it is directed toward the matériel and persons of one's own community, and by definition is carried out without communication of the releasing signal by authority.

Thus, in our own technologically sophisticated society, it is readily apparent that it is possible for half of the national budget and a substantial proportion of our young men to be mobilized to fight an enemy seen by few and rarely recognized even when seen. Lethal weapons are employed by technicians who never set eyes on their human targets. Nor can the other side claim a much more personal focus of their military activities. War is an extremely impersonal business conducted by persons whose private motives —apart from the motive of efficient participation in the state of mobilization—are highly diversified.

The Interests Served by War

We have, so far, discussed the psychological preparations required for a people as a whole to conduct war effectively and have argued that little more is required than a population trained to respond affirmatively to the mobilization signal and to carry out orders from recognized authority. But what determines the communication of this signal?

The signal must be given by a person or group recognized as having the responsibility to do so when the situation requires it. This, in contemporary industrial societies, is apt to include at least some of the persons who will make policy during the mobilization state, but in general it is not necessary that the body that gives the signal for war be the body that directs the conduct and arranges the termination of the war. It is obvious enough that this signal will be given when an authorized person perceives that a threat exists to the continued functioning of the system that cannot be met by the society without shifting to the mobilized state and using lethal weapons against members of another society. When the society is under physical attack itself, the danger is obvious, and war may be the only alternative to abandoning hope of maintaining, or returning to, the traditional form of relaxed state; it may even be the only alternative to destruction. But sometimes even when no serious attack is threatened, the authorized body communicates the releasing signal, the society mobilizes, begins to use lethal weapons, and initiates an extremely costly and, sometimes, fatal conflict.

I have already suggested that war is often perverse. It is well known to pacifist and soldier alike that many wars are unnecessary, disastrous, even catastrophic mistakes. They do not serve the purpose, whatever it may be, for which the society has mobilized, and they cause immense suffering and damage. The sense of moral outrage that such events arouse does not carry us far, however, in trying to understand how these disasters happen. Political witch-hunting and accusations of psychopathology and criminal conspiracy may simply obscure the facts. In one minor war whose inception is very well documented—the Black Hawk War between the United States and the Sac and Fox Indians in 1832—the record clearly shows that the responsible policy-making bodies on both sides were *not* in favor of war. An irresponsible insistence by an Indian faction on crossing the Mississippi River to join forces with a religious prophet, and lack of discipline in an Illinois militia detachment, precipitated the first firing of guns, and a sequence of events followed mechanically that resulted in the death, from disease, starvation, and bullets, of several hundred Indians and whites. The critical event was a misunderstanding. The Indians, disillusioned with their prophet, attempted to surrender to the militia before a shot was fired in order to gain free passage back across the Mississippi to their tribal territory. The militia were drunk, had no interpreter, and were unaccustomed to discipline, and fired on the peace party. In the ensuing melee the militia were defeated by the Indian warriors, who then fled with their women and children in an effort to escape across the river by a different route. But the use of lethal weapons on a militia detachment automatically set in motion a sequence of communications that resulted in the mobilization signal being given by the President of the United States. The Sac and Fox council, however, refused to broadcast *their* signal, and the fighting was restricted to the east bank of the Mississippi; the Indian territory across the river was not attacked.

Such examples could, of course, be multiplied *ad nauseam*. The point they illustrate is that unwanted wars—and most wars are now unwanted—occur as a result of a perversion of administrative process rather than as a result of popular folly. The types and sources of such perversions are complex. In some cases, the psychopathology of administrative personnel is evidently responsible (the case of Nazi Germany is the best example of this type). In other cases, responsible and intelligent administrators attempting to act in the best long-term interests of their society are precipitated by misinformation, communication failures, and a rigid, poorly designed system of decision making into unnecessarily mobilizing the society for war.

From this point of view, it would appear that the administrative structure of any society—and every society has an administrative structure at least latent during the relaxation phase and active during its mobilization phases—is extraordinarily vulnerable to perversion in regard to war decisions.

The Prevention of War

There are few people who take the position that *all* war is a mistake or is morally wrong, and who refuse therefore to mobilize for war on behalf of their society in any role and under any circumstance whatever. Most pacifists refuse to kill personally but support mobilization in other ways. Generally speaking, organized opposition to war is opposition to *a* war that is believed to be morally wrong or, practically, a mistake. These opponents of war are willing to fight if mobilized in what they regard as a good cause. Nonetheless, despite the rarity of true and radical pacifism, there are few persons in industrial countries today who would deny that preventing war from occurring is a task of paramount importance. It has come to be recognized as one of the principal unsolved problems of mankind.

Short of universal pacifism or the inclusion of all countries in one state, the means of preventing war would seem to lie in the invention and diffusion of more effective political and administrative processes. It is, to put it crudely, a problem of developing a number of interrelated "fail-safe" systems that will reduce the probability of mistakes (in technology, in intergroup relations, in communication, and in personality function) from precipitating a war while other means of resolving conflicts of interest are being employed. The kind of fail-safe devices to which I refer are not merely sophisticated electronic systems, which control the weapons themselves. They are also principles in human relationships that, making use of what we already know about human beings, minimize the likelihood of any society perceiving itself as being in a situation of external threat so dire that war or destruction are seen as the only alternatives. Not all such intersocietal threats are economic and military; perhaps the most dangerous threats of all are threats to self-respect and threats to interfere with local revitalization movements.

It is not very likely, in the immediate future, that universal disarmament or a single world state will come into being. Nor is it desirable, even if it were possible, to eliminate the principal psychological preparation for war—training for mobilization—for societies must be able to mobilize for other purposes, even if not for war. And it is irrelevant to propose that undeluded, non-hating, freely loving young people be raised and nourished, for they will be the best fighters of all. If the last century has taught us anything about human nature, it is that good persons can do impersonal evil and that war does not require hate.

Conclusion

In conclusion, my argument may be summarized briefly as the assertion that the main process of preparing a people for war is simply training them to participate obediently in mobilization for concerted action in emergencies. War does not require training a people to hate an external enemy. Since training for mobilization is unavoidable, and the elimination of intergroup hostility would be irrelevant, it is clear that the prevention of war will not be accomplished either by eliminating its basis in psychological preparation or by improving human nature. Rather, the problem of ensuring peace must be approached by the innovation of political and administrative safeguards that guarantee that alternative processes of conflict resolution are not interrupted by war-by-mistake.

War and the Draft

by Sol Tax

In addressing questions of policy in our society, my task as an anthropologist is not simply to express my citizen views, however well founded in special knowledge; nor simply to serve up warmed-over expertise of colleagues in the most relevant disciplines. Rather, I begin by putting the issues in anthropological perspective, by examining the process of decision making relevant to United States manpower procurement, and thus pose new questions for laymen and experts alike.

Large questions of war and peace require the very broad perspective provided in most of this symposium. My question is relatively small. In the U.S.A. in the late 1960's, should government force some persons to become soldiers, and if so, which persons? Given the practices of (1) taking property from all people (taxation, applied uniformly, either absolutely or relative to ability to pay) or from a few for presumed social necessity (eminent domain, etc.); and (2) taking life or liberty from persons deemed dangerous to society, after "due process of law"—the issue then becomes: should government take life and liberty from selected innocent persons for the public good?

Bypassing the special case of an emergency in which the prospect of destruction is immediate and visible, the question is whether individuals should be drafted into military service when the danger is not overwhelmingly apparent.

"The draft" is a system of military manpower procurement that can be put into perspective by describing three others, which I call the "Spartan," the "warrior caste," and the "voluntary" systems. In the Spartan system, at least all male citizens are born to be warriors, trained from childhood and hopeful of getting their chance for glory. This system is characteristic of tribes in whose cultures war is important. In the traditional Navaho society, for example, all of the able-bodied population were potential warriors. After the age of seven, boys were subjected to rigorous physical-fitness training. Their diet, exercise, and sleep habits were carefully scrutinized. An indoctrination was begun that would result in a fierce pride in masculinity. To the Navaho, masculinity was almost synonymous with accomplishment in battle. This indoctrination also instilled the group paranoia necessary for continuation of the system. "If you sleep late, the enemy will come and kill you. If you are awake, you can face your enemy and die like a man." The approach of the enemy was always felt to be imminent. Dissent from the system did not exist. The big day in the life of a Navaho boy was when he was allowed to join a war party. If the boy had done well in his training, usually this occurred between the ages of seventeen and twenty.

The warrior caste system is characteristic of larger societies, in which a special geographic subdivision or else a class of society supplies the standing army. The warrior caste itself tends to have a Spartan system, with ideals of bravery and glory instilled with military training from childhood. An examination of the traditional system of the Kerala in India will serve to illustrate how this system functions. The militia is a leisure class. All retainer Nayar boys are inducted to the king's service at the age of seven. They train in gymnastics and swordsmanship for nine years. When they "graduate" they receive their arms from the king. They remain in military training until they are obliged to leave the king's service and to succeed to the head of their matrilineal property-group to manage lands.

The third alternative is a voluntary army, which in peacetime is small and "professional," and in emergencies is swelled either by sufficient increase in volunteers or by recourse to the draft.

Any discussion of means of recruiting military personnel is complicated when one makes the usual distinction between officers and soldiers and both their means of recruitment and the psychology and consequences of their service. In the Spartan type, to speak either of "volunteers" or of "conscripts" is meaningless; all non-Spartan societies, whatever their military system, might in emergency add to their strength

Sol Tax is a professor at the University of Chicago, and the editor of "Current Anthropology."

either volunteers or conscripts, or both. There are societies, however, in which the central system is the draft. In surveying the Human Relations Area Files, one finds the draft so common in feudal-type societies that one is tempted to call it the feudal system. Although feudal societies have had military castes, generally they also have recourse to the draft. For example, in traditional Burma the standing army was furnished willingly by one geographic location; however, all citizens were eligible for the draft. When the king issued a draft call, he gave quotas to his underlords, who in turn divided up their quotas among local officials, who were then free to obtain the needed number of men in any way they chose. Usually, a local official issued the first call to the rich, who he knew would bribe their way out of it. He could then use this money to pay off his own superiors if for some reason he could not meet their demands. The men finally sent were those who could not get out of it by some means, fair or foul.

The pressing of people into service by force may be called conscription (as opposed to ascription in the Spartan and the warrior caste societies). Systems of conscription could be classified in many ways—to include everything from permanent enslavement to brief military periods of training or service in public works. For example, the Russian czars conscripted citizens for twenty years as compared with our two years; but I gather that the Russian conscript assumed that it was for life, or at least that he would find it difficult to return except as an old dependent.

The problem in our country seems to be that while on one level there are inequities in the system of Selective Service that are difficult to resolve, there is also impatience with the draft system as a whole. This suggested to me that I had better analyze the current situation in the United States in light of our own evolving cultural values precisely as I would hope to do in a hitherto undiscovered culture in the New Guinea highlands.

It has been said that Vietnam is the most unpopular war in our history. If this is true, we might hypothesize that it conflicts with some traditional American values. Therefore I set up a chart to check this hypothesis. The first thing I needed to do was to check my history to see just how popular other U.S. wars had been. The second thing I needed to do was to isolate the various American values that have led us into war in the past and to see how these operated in the various American wars. The result was the chart I call "American Wars: Motives, Reasons, and Popularity," *see page 56.*

As I see it, there have been basically three reasons why we have gone to war: (1) Our national security was in danger. (2) We wanted to acquire land or economic gain. (3) We were provoked to fight for some rationalized form of idealism. In regard to the last, three rationalizations appear most clearly. One of these I have called the missionary spirit. This can be characterized most clearly by the World War I slogan, "Let's Save the World for Democracy." Another of these rationalizations degraded our opponent to something less than human. This was a very strong factor in our annihilation of the American Indians—they were said to live like beasts, and therefore deserved to be treated like beasts. Still another was characterized by the feeling that our opponent was not taking proper care of his charge (be it government or land) and that we could either do a better job or needed it more anyway.

Arbitrary value judgments must be made in completing such a chart. Should one treat the popularity of the war at its outbreak? It's conclusion? Or in total? I chose the last. Should one treat the real rather than the purported threat to our national security? I chose the former—which of course called for a number of other judgments that might be very shaky. Where I saw no basis for judgment, the space is blank. Therefore, the reader should feel free to rearrange the figures on my chart to his heart's content or to add some. Which brings us to the question of what the numbers represent. Rather than try to state the absolute amount of dissent over any war or the absolute amount of avarice that provoked the war, I rate the wars only relatively. Therefore, what the figures say is that the greatest threat (rated 12) to our national security occurred in World War II and the least threat (1) to our national security is occurring now in Vietnam; that the greatest national unity in favor of a war occurred during the Colonial Indian wars (12), etc. Remembering all the limitations of this chart, and admittedly there are many, what kinds of generalizations can we make from it? Three things stand out:

1. National unity is high, and the war popular, when either or both measures of interest (security, expansion or economic gain) are high. Thus the Indian wars and World War II were most fully accepted. It should be noted that the most idealistic and most popular of our wars were the Indian wars. And yet, in retrospect, these seem most immoral to many in the twentieth century, since the idealistic rationalization that the Indian needed to be turned into a European (culturicide) is no more justifiable today than the taking of the land.

The war with Spain was accepted even though national interests were not highly involved—presumably because patriotism was artificially whipped up, and the war was won before it had dissipated. The Korean war was also accepted (at least for its first year) although our security was little threatened and we had nothing economic to gain; this relatively successful excursion in idealism was accepted partly in hopes that through the United Nations (which supported the war) we might gain security.

2. Wars for territorial expansion or economic gain —when national security is not also at stake—are rationalized in the least idealistic terms and are not accepted. Thus the War of 1812 and the Mexican War. Again the Spanish-American War was a partial exception. Cuba and Puerto Rico were popular additions to our territorial sphere. Not so the Philippines, which were seen as too difficult and expensive to gov-

ern, and were thus always destined for independence.

3. When there is doubt that the war serves our interest (this is seen if no high figure appears in either of the two "interest" columns), it is only partly accepted. The war in Vietnam and, in lesser degree, the Revolutionary War and World War I fall under this rule. It is now time to review our current interests in Vietnam in this light. It is said that we are fighting in Vietnam to protect our own national security against the Communist threat and that if we do not stop the enemy now, we will have to stop them later—in San Francisco. But a great many Americans evidently doubt the reality of the danger. And if the danger seems to them not real and present, this may seem rather a preventive war, putting us in the position of the policeman who justifies shooting into a group of teen-agers because statistics say that some percentage of teen-age groups turn out to be dangerous. Against this doubtful danger to our security, many Americans weigh the destruction of the homes, fields, and the women and children of South Vietnam.

When our national security does not seem to be in danger and there appear to be no economic interests, *then* idealistic rationalizations come into question. Hence, many doubt our right to interfere, as well as the virtue and sincerity of our missionary spirit, and suspicion arises abroad that we have territorial aspirations. Our sensitivity to world opinions adds to our unease as perhaps never before in our history.

However, after refreshing my memory on the history of dissent and after checking with historians, I quickly reached the conclusion that this is certainly *not* our most unpopular war. The reason this is so is that our purported reasons for fighting are entirely within our tradition. The missionary spirit that we have professed so long may indeed have trapped us. If we shun it now, we may have to admit that other wars have also been fought for the less idealistic motives (economic or territorial gain). Hence, we may have been carried on into a medium unpopular war by idealistic inertia.

AMERICAN WARS: MOTIVES, REASONS, AND POPULARITY

	RATIONALIZATIONS OR IDEALS			NATIONAL INTERESTS		POPULAR ACCEPTANCE
U.S. WARS	Missionary Spirit: they need our help	They are inferior anyway	Our need is greater; we can do a better job	National security: self-preservation	Territorial or economic gain	
Vietnam	11-12	•	•	1	•	5
Korea	11-12	•	•	2	•	8
World War II	•	•	•	12	•	10
World War I	7	5	•	7	•	7
Spanish-American War	8	•	8-10	4	7	9
Civil War (North)	3	•	6	9	•	4
Civil War (South)	•	2	8-10	8	•	6
Mexican War	4	6	8-10	3	8	2
War of 1812	•	3	7	5	9	1
Revolutionary War	•	•	5	6	6	3
U.S. Indian wars	1	12	12	10	12	11
Colonial Indian wars	10	8	11	11	11	12

If the Vietnam war is not—relatively—extraordinarily unpopular, why are we having extraordinary trouble obtaining manpower? The answer would seem to be that this problem is not at all uncommon. Opposition to the draft is as old as American war itself. In some cases, it has been a result of dissent over the nature of the particular war. Those who feel that either the draft or the war itself is unfair to them have always refused to fight. Whereas we have traditionally harassed or prosecuted our pacifists, we have not until recently had legal means to prosecute draft dodgers.

But if the draft is so unpopular, why do we continue to use it? Why do we not consider either of two major alternatives to the present draft discussed at a recent conference at the University of Chicago? One proposal would incorporate the present draft into a system of *national service* going well beyond military functions and including a much larger segment of the population; the other would abolish conscription and establish a purely professional *voluntary* army.

Those of us at this conference who were—as it began—uncommitted to any particular solution to the problem of military manpower procurement were particularly impressed by what we learned favoring voluntary service. Two congressmen—one a Republican and the other a Democrat—attended the conference, and both came away enthusiastic for this solution. Yet the House of Representatives did not seriously consider either this alternative or the possibility of broadened national service. Two senators attended the conference and both favored reforms in the present system, many of which their chamber accepted. But even these reforms were rejected by the House. And the House view prevailed.

In the American system of representative government, it is assumed that the conclusion must represent the will of the American people; yet opinion polls and other evidence contradict this. In the anthropological tradition, it is necessary therefore to seek an answer to our questions in the "real" structure of the U.S. law-making system.

The United States theoretically leaves international decisions in civilian hands. The military carries out policies of the civilian President and the people, through their representatives in Congress. Congress must do its complex work through committees; committees have administrative staffs who provide continuity through changing elected administrations. The executive branch also does its work through staffs that continue from one administration to the next. These staffs are continuing groups with lives and interests of their own. Elections come and go; Presidents and Congresses change; but the committees and staffs remain and, as experts in their fields, educate their new chiefs. We cannot assume that the military is subservient to civilian control in our system until we have examined the actual status relations among these staff people. In dealing with the American Indians for example, the congressional staff is dominant in determining policy (a worrisome fact because their tradition dates back to the days when Indian affairs were in the Department of War); but the Pentagon staff people—often in uniform—may well be dominant over congressional committee staffs.

The congressional committee staff of experts must educate the new congressmen to what they conceive to be the fixed "policy of Congress" (an often-used phrase). How much of this policy of Congress with respect to military matters comes from the tradition in the Pentagon would depend in part on how technical and bureaucratic the issue; manpower procurement could well involve a set of problems in which the congressional staff people bow to their colleagues.

Any committee chairman and House minority leader depend heavily upon, and work exceedingly closely with, the committee staff. The chairman and his counterpart (who change places when the majority changes) grow into their positions over the years, advancing through seniority and interest in this committee rather than in others of which they are members. Indirectly through their staffs, as well as directly, they co-operate with the related executive office. In many cases there is the usual horse-trading that is necessary in the arts of both politics and administration. Congressional leaders—who get their seniority through being continually re-elected—need to provide facilities for their districts; it must be that the large military budget makes co-operation especially easy between congressional committee leaders and top Pentagon personnel. Since the congressional committee is exceedingly influential—at least has virtual veto power—in making legislation, its leaders in large part are the filter through which policy passes. The individual congressman may or may not have a "national" point of view; he must—to achieve leadership—be re-elected. It is his particular constituency that he must please. If his district for any reason favors one policy or another, he tends to follow this policy, which may not reflect either the national opinion or what others would think the national interest.

So it is not Congress but congressional committees; not only these committees, but the traditions of their staffs and the interests of their leaders and their small districts that largely determine what laws are made.

There is another influential circumstance that may bear upon any issues involving defense. Other things being equal, the election of a war veteran is easier than that of his non-veteran opponent; and support of veterans' organizations is useful. Therefore, members of Congress are disproportionately veterans; rare is the election of a conscientious objector!

Thus, while the public may disapprove of the draft system, it does not necessarily follow that their opinion will be translated into law, given the *modus operandi* of our Congress and congressional committee system, and given the influence of the "Pentagon rationale," which persuades these groups. Having thus traced the endorsement of the Selective Service system to its source, the question must therefore be asked, why does the Pentagon prefer the present Selective Service system to any alternative?

Usually three reasons are given. The first and most common has been that it is the only system financially feasible for the military. The second is that they need the mechanism for quickly swelling their manpower resources in case of emergency. The third is that the military would lose prestige, and hence, morale of its personnel would lag if the system were abandoned. Since all of these objections can be refuted (see *The Draft: A Handbook of Facts and Alternatives*) perhaps the compelling reason is structural. The military is based on hierarchy and power; indeed wars could hardly be managed without power applied within the system and, of course, to the enemy. The power to conscript is simply part of the power that any military establishment should want.

It is precisely because the military depends upon hierarchical authority and power, while a democratic society stresses values of equality and freedom, that our Constitution places the people over the military. In the case of military manpower procurement, however, the Pentagon appears to rule, and the draft persists despite the contradiction of our most sacred value that innocent people should not be arbitrarily selected and deprived of life and liberty without due process of law.

If there were no alternatives to satisfy our need for national security, this might be conceived of as a simple "necessary evil." But this is not the case! The two major alternatives discussed above need first to be explored.

The first emphasizes the value of equality in American culture. National service for all, perhaps women as well as men, attracts many adherents. If we must draft some, let us draft all; and if we must serve the military, let us also serve civilian society. The Peace Corps abroad could be extended, and our domestic problems helped at the same time that the idealism of individuals could be served and strengthened and the anomy of the large society qualified by work together.

The second alternative emphasizes the value of freedom. End conscription altogether and depend upon volunteers. Assume rather the patriotic idealism of Americans; but make it financially possible for them both to serve their country—for any period of time—and to support their families and begin to save for their children's education. The standing army would be no less civilian because it is properly paid like other civilians; the selection would be no less representative of the population because it comes from free choice rather than from force.

In time of war a nation is in a state of danger and less free than usual to discuss policies fully and rationally. At such a time the nation is particularly reluctant to dispute the military. The defense establishment is therefore at its political strongest. If the war goes well, one does not "rock the boat." If it goes badly, it seems safer to strengthen, rather than to undermine, the establishment. It is, therefore, not likely that the judgment of the military on these basic alternatives to the draft will be upset while the Vietnam war is in progress, nor surprising that Congress does not seriously discuss them. Nor will basic alternatives be fully explored in peacetime when they seem to have no relevance. Thus for twenty years of our first peacetime draft (the draft was re-established after a brief lapse following World War II) it was not a public issue, until we became embroiled in a questionable war. Thus, the American people must choose a moment of peace—but one when a questionable war is still fresh in memory—to discuss alternatives to a policy that violates our sacred values of both freedom and equality.

War and Disease: An Anthropological Perspective

by Alexander Alland, Jr.

Warfare and disease are linked. The historical record is crowded with associations between war and the outbreak of major epidemics. The reasons behind such associations, both biological and behavioral, are far more complicated, however, than is generally assumed. This article is an attempt to clarify such relationships, particularly in the context of the war in Southeast Asia.

While public health as a matter of policy is new to most countries, all human groups, even the most primitive, have made considerable behavioral and genetic adjustments to the common diseases in their environment. The genetic adjustments result from the selective effect of disease on populations, and more than one author has suggested that disease has been a powerful agent in the course of human evolution (Haldane, 1959; Barnicot, 1965). Behavioral adjustments to disease are of two sorts: preventive and therapeutic. Effective therapeutic procedures require conscious effort including both the development of accurate diagnostic techniques and the discovery of curative agents. In many, if not most, primitive and peasant societies the diagnostic process is concerned primarily with etiology. Disease may be linked to transgression of the moral code, to social enmity, or to supernatural power, with consequent treatment of these "causes" rather than of the disease-producing organism. Generally, primitive medical opinion fails to produce a consistent therapeutic orientation.

On the other hand, many non-Western societies do have pharmacopoeias that are quite effective in the treatment of local irritations and certain general symptoms such as fever, aches, and pains. A few good vermifuges exist, and of course, there are known cases in which primitive or peasant remedies have been demonstrated to contain powerful agents capable of ameliorating such serious conditions as malaria (quinine) and heart disease (digatalis). In general, however, "native" drugs have little effect upon specific disease agents.

I submit, therefore, that of all the adjustments that a prescientific population can make to disease, the most effective are genetic in origin or involve behavior that can be classified as preventive medicine. The term "preventive medicine" is used here in a special sense to include any medically or non-medically directed behavior that, in fact, has a positive or disease-reducing effect on the epidemiological patterns of a population (for example, bathing).

Many behaviors among prescientific peoples are effective in combating or preventing disease. These range from cooking procedures, which lower the risk of intestinal parasite infestation, to customs that require individuals to defecate away from habitation sites and trails. Quarantine for at least some infectious diseases and avoidance of contaminated water are also widely reported. This is not to say that all behaviors are positive in their effect. Indeed, many customs increase medical risk for particular groups. Certain subsistence techniques, for example, while they represent an economic advance for a population, nonetheless produce new routes for infectious agents.

Certain cultural practices that are relatively safe under one set of conditions increase risk if the conditions are changed. Small populations are less likely than large populations to be subject to epidemics, and nomadic groups are less susceptible to autocontamination than settled groups, which live in constant contact with their refuse. However, the sudden migration or displacement of populations from one ecological zone to another may expose them to diseases against which they have no genetic protection.

In general, health patterns depend upon ecological relationships between man, disease organisms, and vectors, as well as upon reservoir populations. These must be considered as part of the behavioral frame-

Alexander Alland, Jr., is an assistant professor at Columbia. His specialty is medical anthropology, and Natural History Press has recently published his "Evolution and Human Behavior."

work rather than as part of the "natural setting" of a population. Such relationships are always tentative considering what man can do to his environment, and there is much evidence to show that the natural setting is rarely natural.

It is unfortunate that no studies exist that weigh positive and negative behaviors against each other. There is evidence, however, that disturbances of normal (meaning long term) ecological and/or behavioral patterns usually lead to increased disease rates and lowered viability. This certainly suggests that the net effect of socially established genetic and behavioral adjustments undergone by prescientific societies is, in fact, positive.

In sum, genetic and behavioral adjustments to disease are part of a general process of adaptation to environment. Public health, particularly in prescientific populations, depends upon such accommodations. I am convinced that the view of public health outlined above is necessary if we are to understand the dynamics of adjustment to disease and the effects of war on such adjustments.

An example from European history has implications for the present situation of war in Southeast Asia. I have chosen plague because (1) its occurrence is well documented, (2) its etiology is complex but well understood, and (3) it serves as a good illustration of a severe, highly contagious disease that is sensitive to ecological variation.

The agent of plague is the bacillus *Pasteurella pestis*. It is a disease with a short incubation period, florid symptoms, and a high mortality rate. Plague has a complicated etiology involving wild and domestic rodents and a flea vector, with the normal endemic focus located in wild rodent populations (sylvatic plague). Epidemics occur when the bacillus is passed on to highly susceptible domestic rodents, which rapidly die out. When this occurs their fleas are forced to search out new hosts, the most common of which is man. While there has been some dispute over whether the European plague was a cause or an effect of social disorganization, most authors today feel that the great epidemics of the thirteenth to sixteenth centuries were the outcome of Malthusian pressures and followed social, political, and economic troubles. R. S. Roberts (1966), a medical historian, writes:

"Plague was endemic for a long time . . . as we shall see, [it] was a disease which could become epidemic only at a particular stage of socio-economic development, which demographers call 'oriental'.

"At the beginning of the outbreak, England was much more densely populated than is usually thought. From 1086 (Doomsday Book) the population seems to have trebled from 1.0 to 3.5 million. In the absence of technical advance or import of foodstuffs, this greatly increased population could only be fed by a commensurate increase in the area of cultivated land. The inclosure of waste land and the settlement of new villages in the thirteenth century shows that this indeed was done on a large scale.

"It was the social and economic crisis of the 1340's however, which seems to have created the necessary conditions—rats brought into closer contact with man in the search for food after bad harvests, movements of populations after famines and epidemics, overcrowding in certain areas, and a general decline in health and resistance to disease."

Judging from Roberts and other sources the spread of plague in England, and perhaps other parts of Europe as well, was facilitated by the destruction of woodland, which was converted for agricultural purposes. Such incursions into the native habitat of wild rodents, the endemic reservoir of plague, brought these animals into closer contact with the domestic rat population. As I have noted above, domestic rats are highly sensitive to plague, and as they die out, the human populations among whom they live rapidly pick up the infection. Probably the epidemic cycle was completed when the natural habitat for wild rodents was reduced to the point where it could no longer support the reservoir population. In this case it would appear that the partial destruction of an ecological zone increased disease risk although further incursions into the same zone eventually led to an extinction of the endemic focus of the disease.

The parallel between this situation and Southeast Asia is striking. Plague and other acute infectious diseases exist in endemic focuses throughout the area. The flood plains of the Mekong Delta support one of the highest population densities in the world. In addition, the agricultural complex constitutes an ecological niche quite apart from the wild mountain zone. Until recently, Vietnamese from the plains were afraid to venture into the mountains, often citing exotic diseases as the cause of their anxiety.

Hygiene and public health measures are primitive, but under normal conditions, severe epidemic outbreaks are limited in their distribution and scope. While the population is certainly not the healthiest in the world, a delicate balance exists that has allowed humans to survive and multiply in great numbers. This is due in part to the incredibly productive nature of the delta area.

Although epidemics of the plague have not occurred for some time, the number of cases in Vietnam has mounted steadily and sharply over the past three years. On August 20, 1966, *The New York Times* noted that the plague, at that time, had infected 22 of 29 provinces stretching north of Saigon, but that in 1961, plague was reported in only one of those provinces. The same article presents the following statistics on plague incidence in South Vietnam: 1954-1962, less than 40 cases per year; 1963, 119 cases; 1964, 290 cases; and 1966, 4,453 cases. The Rev. Do Van Quy, chief of the Pasteur Institute's plague laboratory predicted that "This problem will not be solved until the war is ended." Dr. Joe Stockard, chief of the United States aid mission's preventive medicine section said "now that the disease has become so widespread a high incidence may be expected to continue for an indefinite period."

Extremely crowded conditions in the cities with overstrained and primitive sanitary facilities are no doubt a major factor in the statistical increase. U.S. and South Vietnamese authorities are aware of the problem, at least insofar as it relates to cities, and a program of rat elimination is under way. The dangers inherent in such a program are minimized by the existence of a relatively effective plague vaccine and effective antibiotic therapy. Nonetheless, a case of the plague in an American serviceman was considered important enough to be included in the *AMA News* for December, 1966.

Rat elimination is a rather quixotic pursuit in Southeast Asia. The ability of rats to survive even in the urban areas of the United States attests to their hardiness. Rats flourish in the primitive sanitary conditions in the slums and *bidonvilles* of Vietnam. It would seem, therefore, that an effective antiplague program should be more concerned with interrupting the routes of infection from the endemic focuses to the domestic rodent population. What has happened may be the reverse! Defoliation and extensive napalm attacks may have produced disturbances in plague reservoir areas sufficient to increase the contact between wild and domestic rodents. While I must stress that this is mere conjecture, such an explanation fits well with current theories of plague epidemiology. In addition, the fact that plague is virtually absent in the Mekong Delta region for "reasons [according to *The New York Times*] that scientists are unable to explain" lends support to the theory that plague will tend to break out more readily in regions where there has been severe environmental disturbance. Until recently the delta has experienced only limited warfare and no major defoliation programs.

One major difference between the English plague and the Vietnam situation is that in England it was the English who changed their environment, while in Vietnam it is we who are doing so. We are therefore largely responsible for the potential consequences that may now affect a large segment of the population. The U.S. military can easily vaccinate its soldiers and a good part of the urban population, but what of the civilian village population, particularly in uncontrolled territory? According to Vietnam government statistics only about a quarter of South Vietnam's population has been immunized with plague vaccine (*The New York Times*, Aug. 20, 1966).

Plague stands only as a model for what can happen when a natural setting is disturbed. Such waterborne diseases as typhoid and cholera, as well as various forms of dysentery and intestinal parasites, constitute a constant danger in Vietnam. Even malaria is sensitive to environmental changes that affect the breeding grounds of vector mosquitoes.

The ecological situation in Southeast Asia, as in any tropical area, is quite complex. This has two major implications for epidemiology: (1) The climate, both warm and humid, provides a benevolent setting for a wide range of infectious parasites. Organisms that would under other conditions have difficulty surviving outside of their human hosts remain viable for long periods in water supplies and in the soil. (2) Disruption of the ecological balance within either the settled and/or less densely populated areas can produce changes in both floral and faunal composition that, at the very least, are difficult, if not impossible, to anticipate. Some of these changes are bound to affect epidemiological patterns.

Extensive warfare in any part of the world has always had the side effect of producing severe impairment of public health facilities and of disrupting normal life patterns for civilian populations, which, in turn, are often correlated with rising disease rates (Zinzer, 1934; Ackerknecht, 1965). The imposition of modern warfare on Southeast Asia, particularly a war that is fought principally against guerilla forces with no distinct battle lines, creates serious problems for the health of the entire population. Taking the tropical ecology and the type of warfare into account, the following factors can be expected to affect epidemiological patterns.

1. With vast areas of the country under only tenuous control, it is impossible to impose any effective public health measures on the population at large. Potential epidemics are difficult to check, and the endemic focuses of disease cannot be wiped out.
2. Defoliation of forest land in guerilla-held territory drives wild animal populations into new areas, increasing the risk of contact between animal reservoirs, potential domestic animal carriers, and humans.
3. The dislocation and relocation of large segments of the population increase the possibility that groups from different ecological zones will cross-infect each other with exotic diseases against which they have no genetic or acquired immunity.
4. Both relocation camps and cities become overcrowded. Increased population densities and poor sanitation, combined with inadequate diets, increase the risk of epidemics.
5. Disruption of the local ecology and indigenous behavioral patterns leads to the breakdown of existing barriers to disease.
6. The stress associated with relocation, lowered nutritional standards, and cultural deprivation due to changes in traditional life patterns is sure to lower resistance to common diseases. Under such conditions, normally benign diseases can become serious health hazards for the population.
7. The increased disease risk produced in such groups may last long after a return to normal conditions. Wolf (1960) cites evidence that a prison-camp experience can have a striking effect on the continuing life chances of exposed individuals:

"A recently completed study of the effects of imprisonment on Americans during World War II furnished revealing information about approximately 94,000 United States prisoners of war who were taken in Europe. These men were imprisoned for about ten months. Less than one per cent of them died before liberation. In contrast, in the Pacific theater, about 25,000 Americans became prisoners of war. They remained in prison four times as long as those captured in Europe, and suffered far more threats, abuse, and humiliation. Their demoralization was often extreme. More than one third of them died in prison.

"Six years after liberation, the fate of those that survived the Japanese prison experience was investigated. In the first place the total number of deaths in the group during these six years was more than twice the expected incidence for a similar group not so exposed and three times as great as the group of United States prisoners of war in Europe. Moreover, the causes of death included many diseases *not directly related to confinement or starvation* [italics mine]. Twice the expected number died of heart disease, more than twice the expected number of cancer, more than four times the expected number of diseases of the gastrointestinal tract. Twice the expected number died as a result of accidents. Nine times the expected number died of pulmonary tuberculosis."

Now one might argue that the Vietnamese peasant relocated to camp or city has had a more rugged initial life experience and therefore is more immune to stress than his American contemporary. One might also argue that life in Vietnamese relocation camps is not comparable to life in Japanese prisoner of war camps. It must be admitted that we do not know what effects, if any, will appear in the incarcerated segment of the Vietnamese population several years from now, but published descriptions of the camps suggest that severe stress is an everyday experience.

It is therefore possible that we are risking the health of relocated and incarcerated individuals, possibly for a long time to come. Furthermore, this concerns a very large segment of the South Vietnamese population. Over 600,000 people have become refugees from American bombing and/or Vietcong attack. One hundred thousand of these are in relocation camps while the remainder are left to their own devices. This is perhaps the first war in which a major segment of the civilian population has been so uprooted for so long. (One must include the Japanese occupation and the war with the French along with the present episode.)

8. The life risks of individuals not directly involved in relocation or evacuation may also be increased. According to Wolf:

"The main point is that the great majority of the clusters of illness occurred in the lives of the members of every group (an experimental study of life stress in civilian populations) at times when they perceived their life situations to be unsatisfying, threatening or overdemanding and productive of conflict, and they could make no satisfactory adaptation to these situations. These situations were in general those which arose out of disturbed relations with family members and . . . associates, threats to security and status, restrictions and limitations which made it impossible to satisfy important personal needs and appetites."

This kind of dislocation certainly occurs in all war, and even in normal circumstances, but the Vietnam conflict, which has dragged on for so long, is particularly contributory. The new weapons used in Vietnam today, with the exception of defoliants, are merely an extension, albeit a terrible one, of "conventional" weaponry. But their vast destructive power, combined with our efficient, varied, and numerous delivery systems, used over and over again, year after year, is bound to have new and unhappy consequences for the entire ecology of Vietnam and for the majority of its civilian population. While I do not believe that the United States has used or intends to use biological warfare in Southeast Asia (it is perhaps of more strategic value for an area in which there is little or no troop commitment), I submit that the kind of conventional warfare that has been raging for the past three years is, intentionally or not, a kind of covert biological warfare. The continued imposition of stress conditions upon an area with a delicate health balance will, in a variety of direct and indirect ways noted above, subject the inhabitants to the same type, if not the same degree, of pathological devastation as that brought about by overt action involving biological and chemical agents.

The Effects of Warfare on the Biology of the Human Species

by Frank B. Livingstone

Warfare, however defined, includes many different kinds of conflict. Even for the Murngin, a tribe of Australian aborigines, Warner (1930) lists six different kinds of "warfare," and the great technological changes in the last few hundred years have markedly changed the nature of modern warfare. It would therefore seem likely that few, if any, biological effects are common to all these different warfares. "Intergroup aggression" is perhaps closest to defining my subject since I will be concerned with both the possible effects of modern, "civilized" warfare on present and future generations and the effects of past warfare on the present composition of the human gene pool. To be sure, warfare is a cultural phenomenon, but genetic change takes a long time; our present genes may be due to adaptations of our prehuman ancestors. Hence, the genetic and demographic aspects of aggression in other animals may be of use in an analysis of human aggression.

Several possible biological effects of the various kinds of warfare come to mind, but it should be emphasized at the outset that some are only possibilities. Therefore this paper, and others like it, are speculative for the most part. Wright's (1965) massive compendium contains the available demographic statistics on wars of the last few centuries—and there are

Frank B. Livingstone, who is a professor at the University of Michigan, concentrates on physical anthropology and human genetics.

many—but I know of no study that demonstrates with any certainty a specific genetic change attributable to warfare. For the most part I will be concerned with the genetic and demographic effects of war; that is, whether war has altered the gene frequencies of any population or influenced the population's size.

First, and most obvious, the death rate of young males is increased by warfare, and usually the death rate of the rest of the population, particularly the weak and very young, is increased. Presumably, due to the same consequences of war, the birth rate should decrease, and this often happens. But it is a fact that the birth rate actually rose in England and some other European countries during World War II, and such a rise invariably occurs after a war. The frequency of birth malformations also has increased during wars (Stott, 1962), which seems plausible, since such results can be obtained by subjecting animals to similar environmental stresses during pregnancy.

With the introduction of atomic weapons, the hazards of previous wars have been increased by the deleterious effects of radiation. The numerous studies of survivors of the atomic attacks on Hiroshima and Nagasaki indicate an increase in leukemia in those exposed to radiation (summarized in Neel, 1963). There is an association between leukemia and chromosomal damage, so it would be reasonable to assume that the gametes, particularly the sperm, should also be affected. But detailed studies of the offspring of atomic bomb survivors produced little evidence for genetic damage by radiation. Only one measure of genetic damage, the sex ratio, appeared to be significantly altered (Neel, 1963). However, children exposed to radiation *in utero* have a much higher rate of mental retardation (Wood *et al.*, 1967). The increase in radiation by military operations and testing, as well as the peaceful uses of atomic energy, has undoubtedly increased the mutation rates to deleterious genes in the human species, but this effect of atomic warfare seems to have been overestimated, particularly by the press, political pressure groups, and in novels such as Huxley's *Ape and Essence*. In fact, evidence seems to be accumulating that changes in food habits and the increased use of a multitude of new drugs have had more effect in increasing mutations. Recent studies on the effects of LSD on leukocytes, for example, show enormous chromosomal changes. If similar damage is present in the reproductive cells and if reports of the widespread use of this drug among college students are true, this one drug has probably caused more mutations than all the atomic explosions thus far.

The last two World Wars have been responsible for enormous numbers of deaths, but it is nevertheless questionable whether they have had any permanent demographic significance. Certainly the effects of war on the birth and death rates have caused a decrease in population. In the case of Russia during World War I and the subsequent revolution, the deficit between expected population and the actual figures was about 5,000,000 during the height of the fighting and famine; but the population had recovered by 1927 (Lorimer, 1946). In World War II approximately 9 per cent of the U.S.S.R.'s and 5 per cent of Germany's population were killed, while for England and France it was only 1 per cent, and for the United States an infinitesimal 0.2 per cent. When we consider that these slaughters occur about once a generation, the conclusion seems inescapable that they have no significant effect on the population growth or size and do not act as forces controlling the population despite the enormity of the slaughter in round figures (for the world it comes to about 51,000,000 in World War II). For Europe and the United States, the economic depression of the 1930's had almost as much effect on the birth and death rates. Furthermore, Wright's (1965) statistics show that the twentieth century has been the most lethal both in terms of numbers and percentages; so that during the Christian Era warfare has not been a major force controlling the size of human populations. Even today the number of young men killed in automobile accidents in one year, which is itself less than 0.1 per cent of the age group, is greater than all the American deaths in the Vietnam war through the summer of 1967. This limited participation of the population in wars, and the extremely low percentage that is either killed or wounded, have been characteristic of the United States since its birth. I'm not sure that this indicates a lack of patriotism, but it is a fact that when the Capitol was burning in 1814, only 0.2 per cent of the population took up arms to save the country. Only in the Civil War did 10 per cent of the population become engaged in fighting each other, and 1.3 per cent was either killed or wounded.

Given the negligible effects of modern warfare on the size of human populations, it would seem to follow that it has little effect on genetic evolution. As Haldane (1953) has emphasized, those forces that tend to limit the size of the population have the greatest effect as agents of natural selection. Aside from the effects of ionizing radiation on mutation, warfare would most likely influence the two other forces of evolution: natural selection and migration. The two World Wars have been major causes of the huge migration within and from Europe (Kulischer, 1948). In this way warfare can account in part for the variability in genetic characteristics among human populations. But genetic differences, whether actual or postulated, must be due to natural selection.

Natural selection changes the genetic characteristics of a population by either a differential mortality or fertility of the specific genotypes. In order to be an effective agent of natural selection, warfare must thus account for a significant amount of mortality or differences in fertility. Crow (1958) devised an index that measures the amount of selection that can occur, but this does not mean that it actually will. It is necessary to show that different genotypes have different mortalities from the agent in question. The differences in mortality or fertility are expressed by differences in fitness, which is defined by geneticists as the individual's or genotype's contribution to the next generation.

The problem then arises as to the magnitudes of the differences in fitness within the human species and the differences caused by warfare.

The mortality figures I have quoted above indicate that modern warfare could not have had much effect on the ongoing evolution of man. Even if the selection were maximum or only one genotype was selected out by warfare, it could not change the fitness of a common genotype by more than perhaps 5 per cent. This emphasizes the point that most genetic change takes a very long time: with this amount of selection it would take about 25,000 years to replace one gene. The human species just hasn't been civilized that long.

I think a further implication of this analysis is that the eugenists are unduly worried. It is frequently said that modern war, by selecting the healthiest and most intelligent for combat, is selecting for deleterious genes. First of all, however, the amount of possible selection is small since the percentage of the population killed in warfare itself is so minimal as to be ineffective. In addition, this percentage was highest during the Civil War, for which Hunt (1930) estimates that out of a total of 5,281,683 males in the North between 18 and 45 years old, 316,937, or 6 per cent, were killed. But, as Hunt shows, only 4 per cent of living Harvard graduates died in the war; so, if we assume that Harvard graduates have more than average intelligence and behave in the same way as the population, intelligence does not seem to have been seriously decreased by the Civil War. On the other hand, in World War I only 0.6 per cent of the male population between 22 and 49 years old died, while 1 per cent of the Harvard graduates did (Hunt, 1930). The patriotism of Harvard graduates may have increased, but the genetic effects of the war on the level of the population's intelligence were surely minimal.

Although the genetic effects of modern warfare may not be great, the same may not be true for the second topic of this paper, the effects of past warfare patterns on the present composition of the human gene pool. Since warfare is so ubiquitous in the human species, there may be common genetic characteristics that have been selected by warfare. Human behavior has included internecine fighting from the time of *Sinanthropus* and, since Broom and Schepers (1946) found an australopithecene skull with a large rock embedded in it, perhaps as early as 2,000,000 years ago. During the long time when man was a hunter, the social organization of the entire human species, and consequently the warfare patterns, were probably quite similar. The warfare patterns among shifting agriculturists also seem to be comparable throughout the world, and most of the world's populations were at this cultural level for some 5,000 years.

In contrast to modern warfare, the continual feuding among hunters and shifting cultivators seems to have accounted for a much greater proportion of the deaths and thus could have been a major factor controlling the size of human populations. For the Murngin, Warner (1930) estimated that in a population of 700 adult males there were 200 deaths from fighting, or 28 per cent, while the accounts from New Guinea, such as Pospisil's (1958) of the Kapauku or van Baal (1966) of the Marind Anim, seem to indicate an enormous toll from warfare. However, there seem to be few quantitative estimates, although Bennett, Rhodes, and Robson (1959) have recorded a death rate from *tokabu,* or ritual killing, among the Fore of New Guinea of 14 per cent for adult males. For the Yanómamö of the Amazon, a death rate of 24 per cent among adult males from fighting has been recorded by Chagnon, although he thinks this is an underestimate. Nomadic pastoralists, such as the Indians of the Great Plains, and many early empires also seem to have very high death rates due to warfare. Again there are few figures, but Wissler's (1936) compilation of population estimates for the Plains Indians shows a deficit of 50 per cent for adult males in the Blackfoot Tribe in 1805, a 33 per cent deficit in 1858, while during the reservation period the sex ratio rapidly approached 50-50. Finally, for the Valley of Mexico just prior to the Spanish Conquest, Cook (1946) estimates that for a population of 2,000,000, the annual death rate was about 115,000, with 15,000 the result of warfare and subsequent human sacrifice.

Cook concludes for Mexico that the 15 per cent increase in the death rate due to warfare was sufficient to act as a major controller of the population. I think the evidence from areas still inhabited by hunters or primitive agriculturists who are not under the control of a national power indicates the same conclusion, and thus, by implication, that warfare has been a major agent of natural selection. Warfare could also have been a major factor determining the dispersion of human populations at this cultural level, so that it would have effects on the other forces of evolution. The population size and, consequently, the amount of genetic drift, the amount of inbreeding, and the amount of gene flow among groups are all affected by population dispersion. In addition, cannibalism, which is also an ancient human trait and a frequent practice in warfare, could have been a means of transmission of a newly discovered group of virus infections that act like inherited traits (Gajdusek, Gibbs, and Alpers, 1965). One, *kuru,* is found among the Fore tribe of New Guinea and was originally thought to be due to a single gene when it was discovered some 10 years ago, but it is now known to be due to a virus. However, its transmission is still a problem, and cannibalism is one possibility.

Nevertheless, despite these other means by which warfare could influence the genetic evolution of man, its major effect would presumably be by natural selection. So the question arises, selection for what? The obvious answer seems to be fighting ability, which would include both physical and psychological characteristics. Either intragroup or intergroup conflict within a species would probably lead to selection for size and strength. For humans, as well as most animals, the strong, "silent" genotypes are given the most opportunities to mate. Fighting in animals leads to threat behavior; thus, threat features such as beards, manes, and natural warpaint in the form of brightly colored faces are selected for and become exaggerated. Large body size, sexual dimorphism, and these threat features tend to occur together, as in the baboons, who have a rigid dominance gradient and more intragroup conflict. Goodhart (1960) has proposed that beards and the distribution of body hair in man, which is similar in all human groups, although the amount of hair may vary, can be interpreted in terms of threat displays. Beards cannot be explained by climatic adaptation since women and children suffer as much from cold; neither can axillary and pubic hair, and they seem to be unexplainable in terms of any other function. But they do seem to contribute to the threatening appearance of an adult male.

Some of the body-size differences among human populations may also be due to selection by intra- or inter-group conflict. The Nilotic peoples of East Africa and the Vikings of Scandinavia are among the tallest human populations and do seem to have been fighters to a much greater extent than the Pygmies of the Congo or the Bushmen, who, however, did have wars when they had the Kalahari to themselves (Schapera, 1951). Of course, to be a selective factor, success in warfare has to be related to size and strength and not to ability to ride horses, shoot poison arrows, or sneak quietly through the jungle. In any case, warfare may have been one contributing factor to body-size differences, but there were surely other selective factors, such as climate or nutrition.

Finally, the problem as to whether warfare has selected for any psychological characteristics, in particular aggression or bellicosity, raises the question as to the future of warfare and its inevitability. This has always been a popular topic for discussion and never more than at present. Recently two books have appeared that attribute to man an aggressive or killer instinct (Lorenz, 1966; Ardrey, 1966). This view has been widely publicized, implying that the solution to the problem of stopping warfare seems to be to divert this instinctive aggression to other pursuits, for which there have been many suggestions. Sports seems to be a favorite (Lorenz, 1966), but as Haldane remarked (1952), "sportsmen are not usually conspicuous as pacificists." Haldane's suggestion was "an organized struggle against the natural forces which are adverse to men," and recently the space race (Storr, 1964) has been added to the kinds of competition that are thought to be substitutes for war.

Implicit in these suggestions is the assumption that innate aggression is the major explanation for human warfare. If this is accepted, then it seems to imply further that differences in the amount of warfare among human populations are due to varying amounts of this genetic trait. So we are back to the explanation that the Plains Indians waged war because they were warlike. In the past this has not been a useful approach to the problem, but to reject this as an adequate explanation of human warfare does not mean that there are no genetic differences in behavior that are due to selection by warfare. Obviously societies have to recruit individuals for the roles necessary for the society to survive. They do this by placing high value on these roles, which leads to greater procreation by the individuals who fill them. Thus, Lorenz (1966) can be absolutely correct in his assertion that the Plains Indians' behavior is unduly "aggressive" because of selection by warfare. But it still doesn't explain the presence of warfare. As a comparable example for a known genetic trait, the sickle-cell gene is found in high frequencies in Africa *because* malaria is endemic there, but it is not true that Africans have survived in a malarious region *because* of their high frequencies of the sickle-cell gene. The presence of this gene has little effect on the average fitness or reproduction rate of the population. And it also has little effect on the transmission of malaria despite Weisenfeld's (1967) recent effort to demonstrate such an effect. Sickle-cell trait carriers get malaria but just do not die from it. In fact, there is some question as to whether they produce more gametocytes (the forms of the parasite infective to mosquitoes) than normals and thus increase transmission of the disease.

Just as there may have been some selection in some societies for aggression, there may also have been selection at other times and places for the "instinct" of non-aggression. But all human societies have had little trouble teaching their members to kill other human beings, and especially those of another society. And contrary to resolutions by anthropologists, there seems to be no moral revulsion involved. Man can be trained to kill as easily as other animals. Accounts of attacks by gorillas in zoos seem to indicate the same lack of revulsion or "morality," but frequently there seems to be no pleasure or viciousness either. Perhaps the fact that man has been a carnivore for a considerable length of time can account for an ability to kill efficiently, but other carnivores do not kill members of their own species as man so often does. As Scott (1962) says, "The comparative physiology of fighting behavior in animals yields the extremely important conclusion that the primary stimulation for fighting behavior is external; that is, there is no spontaneous internal stimulation which makes it necessary for an individual to fight irrespective of the outside environment. The physiological and emotional factors involved in the agonistic behavioral system are thus quite different from those involved in sexual and ingestive behavior."

If we conclude with Scott that human warfare is not due to any instinct, then we should be able to outline the environmental conditions that lead to warfare and explain why man kills his own species in such great numbers. Very simply, the major environmental factor is an unstable ecological community. When it invades a new area, any animal population will increase up to some optimum density and then fluctuate around this value, which is approximately the carrying capacity of the population's ecological niche. Any animal population that is still expanding in its range or population is thus unstable, and this has been characteristic of the great majority of human populations in the last few hundred years. Perhaps this is just another way of stating a lebensraum argument for war, but it raises the question: what happens when the species runs out of lebensraum? In these ecological circumstances, territoriality, the defense of which leads to fighting, begins to control the size of the population. The behavior associated with territorialism evolves into all kinds of rituals, which establish winners and losers with little loss of life. As Wynne-Edwards (1962) points out, conventional competitions substitute for contests over real rewards, and these select for display characteristics of the competitors. Society can be viewed as an organization that provides for conventional competition.

If we apply these concepts to man, I think that much of human fighting has been found in unstable ecological circumstances, such as the plains of North America after the introduction of the horse. The headhunters of many parts of New Guinea and the Iban of Sarawak also seem to be in unstable environments with some populations expanding until recently. But the elaborate conventions involved in headhunting or coup counting, like the Geneva conventions, indicate that cultures have evolved ritual competitions that include killing members of the same society, by which I mean those individuals subscribing to the same conventions. This is quite different from the competition of other animal species. It is probably due to the recent evolution of man's conventions in the last 2,000 to 3,000 years, but it may also be due to man's unique ability to symbol. Many anthropologists have said that man is the only animal who knows he will die, which also implies he alone knows a vanquished enemy can return later—older, wiser, and bigger.

Man's ecology is different from that of other animals in another way. He alone seems to occupy many different ecological niches, which have very different behaviors and optimum population densities associated with them. Thus, one human population frequently eliminates or displaces another one with a different way of life. Among other animal species there is frequently a considerable amount of fighting among close ecological competitors, and much human warfare has been due to competition between different cultures for the same area. However, it is not usual for one group of animals to replace another of the same species. The fact that man occupies many different ecological niches with different behavior associated with them has prompted Erikson (1966) to refer to human cultures as pseudospecies. Ecologically, they do act like different species, which, I think, is another reason for the great prevalence of fighting among populations of the human species. Genetically, of course, man is one species, and there are no present circumstances where human populations seem to be undergoing the process of speciation that results in one area being shared by two genetically closed populations with different ecological niches. Indeed, the opposite seems to be occurring. I don't think there is any doubt that sooner or later all mankind will be participating in a single world culture.

Most human ecological diversity has occurred since the evolution of agriculture, which is still spreading to some areas of the world inhabited by hunters. Hence, taking the world as a whole, this ecological niche is not at equilibrium. As our estimates show, warfare seems to be a major factor controlling the size of human populations among many primitive agriculturists. On the other hand, and despite Warner's (1930) figures for the Murngin, the Australian aborigines seem to have evolved a social organization that controlled the size of the population without warfare. For the most part the control of population in Australia, as well as among the Bushmen, was by infanticide. With a stable population all the territory was divided into ritually owned home bases of patrilineal kin groups whom no one would think of displacing by fighting. Each family had on the average one son and one daughter, who was exchanged by various systems for a wife for the son. Among the Murngin and other tribes, this was not a direct exchange but involved the participation of many other kin groups. As Warner (1937) points out, most of the fighting was over women who were not exchanged properly. But there was little warfare over space. I see no reason why the human species will not control its population in the near future, but in a different manner, and evolve a social organization with non-lethal, conventional competition for the regulation of behavior and territory.

Alternatives to War

by Margaret Mead

In this essay, I shall consider together all forms of warfare in which defined groups engage in purposeful, organized, and socially sanctioned combat involving killing each other and the willingness to die.

If a people have, as part of their cultural repertoire of behavior, articulated rules that distinguish intragroup from organized extragroup killing, they will be said to have the institution of warfare, whether it occurs frequently or infrequently in practice.

I assume that warfare, as defined here, and the distinction between intragroup and extragroup killing are social inventions without a specific biological basis (Mead, 1942, 1963a). I assume that we must take into account man's capacity to use symbolic means to define who is, and who is not, a member of his own group, and that in man—in contradistinction to members of other mammalian species—there are no built-in, culture-independent devices for ritualizing intragroup fighting. Instead, the capacity to symbolize makes it possible for men to define other men socially in two ways: (1) as comparable to conspecifics, and so inappropriate objects for killing, al-

Margaret Mead is Curator of Ethnology at The American Museum. She is a cultural anthropologist whose work focuses on Samoa and New Guinea.

though often appropriate for physical combat, especially between rivalrous males, or (2) as, effectively, non-conspecifics, and either prey, predator, or rival.

The ethological literature on aggression and territoriality (Ardrey, 1966; Gorer, 1966a, 1967; Lorenz, 1966) seems to me to lack clear discussion of the conditions within which other creatures, non-conspecifics, are neither prey nor predator, but coincidental rivals for the same prey or for the same hunting or nesting territory or even highway. The occasionally reported "battles" between troops of apes or monkeys, and the controversy over the claim that there are yearly "battles" between eagles and storks during their joint migrations over Turkey (London *Times*, 1967), would be cases in point. Territoriality, which within a group reduces conflict, would, under conditions of temporary or periodic crowding, result in something that looked like the least organized form of human group conflict and that might be theoretically regarded as the precursor of warfare. There is still a strong case to be made against identifying the social institution of taboos on murder with any built-in instinctual equipment for the recognition of conspecifics. Nor can we safely assume any built-in aggressive tendency to kill other human beings, or members of other human groups who carry physical or social indicators of belonging to another human group. I would simply argue, as Gorer (1966b) does, that man lacks these instinctual controls, and not, as Lorenz and Ardrey do, that warfare is an extension of built-up aggression toward rivals for mates, territory, or food. But I would add to Gorer's argument the factor of symbolization in man, and argue that the identification of an enemy suitable for warfare, in which others are seen as non-human, is socially analogous to other animals' identification of prey or predator. Conversely, those forms of warfare that are sometimes identified as play—tournaments, conflicts between individual "champions" of rivalrous groups, American Plains Indians' warfare (Benedict, 1959), with death low on the list of counting coup—can be seen as analogies to those conspecific rivalries among certain animals that do not have as their aim (but do have as a by-product) the death of one or the other of the two involved in ritual aggression, and which under conditions of crowding (Calhoun, 1948) may lead to murder.

This argument is still being pursued with inadequate knowledge of human culture by the ethologists; there has been only preliminary experimentation by the ethologists, and the invocation of selected ethological examples by anthropologists. The resolution of the argument is essential if alternatives to war are to be scientifically considered. If the claim of built-in biological aggression—as made by Lorenz, as adumbrated journalistically by Ardrey, and as assumed in many psychoanalytic discussions—were to be substantiated, then the social measures necessary to prevent warfare might include ways of modifying the gene pool or radical changes in diet, which in turn might, as Lorenz believes, have serious consequences for the exercise of other valuable human characteristics. In the present state of the evidence, there does remain the possibility that certain types of aggression may be "built into" some individuals. This would leave open the possibility of differential distribution of relevant genes in different populations—especially in very small populations—and the accompanying possibility that such behavior can therefore be "read in" or programmed culturally in many other human constitutional types. Finally, there may be constitutional types endowed with built-in controls against lethal aggression, where not only conspecifics but also living prey or predators are concerned. It may also be that the production of a social environment in which no living creatures were used as food or pets or work assistants might be sufficient eventually to extinguish the human capacity to kill living things, but alternatively this might make it socially impossible to modulate and teach the difference between permissible and impermissible killing either of other living things or of other human beings (Mead, 1964).

For the purposes of this paper, however, we regard warfare as a cultural artifact, which can be used by any human group but is not specifically biologically underwritten. It is a social invention (Mead, 1940) in the same way that the wheel is a social invention, with the probability that it was invented many times by early man, in the course of the development of language, tools, and social organization. And here one further peculiarity must be mentioned: the distinction between tools and weapons. Tools are extensions of the manual abilities of both sexes, although restricted in some special forms to one sex or the other, and weapons, designed for hunting, defense, and combat, have usually been restricted to males. With a few brief exceptions, social sanction has never been given to the habitual use of weapons by women, and women have been left to fight, when they fought, with only their natural equipment—fingernails and teeth, or temporarily adapted tools such as the digging stick, the distaff, the rolling pin. This circumstance has not been sufficiently integrated into the ethological discussion. It is notable that all consideration of females disappears when Lorenz (1966) reaches his discussion of human aggression. One of the most insightful treatises on the possibilities of innate aggression, William Golding's novel *Lord of the Flies* (1955) creates an artificial society of boys in which females are absent. It may be important to consider that the biological bases of aggression in the two sexes —in human beings as in other mammals—may differ significantly and that the female characteristically fights only for food or in defense of her young, and then fights to kill, without the built-in checks on conspecific murder that are either socially or biologically present in males. Arming women, as has been done in this century, may be a suicidal course.

If war is an invention, we can then examine the functions it has served in the past. And in any discussion of alternatives to war, as in any discussion of any sequence of inventions, it is necessary to investigate whether the functions fulfilled by warfare in the past are functions necessary today in modern society—and, if so, what other inventions can fulfill them better. First, I think, we may insist that a functioning invention will be used at least until rendered obsolete either by another invention or set of inventions, by the disappearance of the function it performed, or by becoming dysfunctional. We can also argue that unless a better invention is found, a previous invention will continue to be used as long as it fulfills some socially recognized function. Recognizing the extent of cultural lag in many cases, we also must reckon with the continuation of earlier inventions even when a better invention exists, as when human labor is invoked in the absence of machines, or when, during warfare and revolution, people return to earlier technologies. It is unlikely at present that the knowledge of warfare—as an invention—could disappear from human knowledge. Therefore this knowledge has to be reckoned with in any discussion of the possibility of a warless world. The knowledge of methods of nuclear warfare has to be regarded as a component of modern culture in the foreseeable future, however much we ban tests or eliminate stockpiles.

Warfare is a known resource whose practice, under a variety of conditions, may be functional: to repel attack; to add territory, subjects, or fellow citizens to own territory; to establish autonomy or freedom from subordination; to provide targets outside the country when the maintenance of power is threatened from within; to provide sources of food or minerals; and even, in some cases, to provide a market for munitions makers or an excuse for the maintenance of a heated up economy that serves a group in power.

What then are the necessary conditions within which this invention will not be used? One condition is the recognition by all relevant groups that scientific warfare would result in the complete elimination of the own group as well, and consequently of the values that its members have been educated to defend. We have in some respects approached this condition today, as far as some of the leadership of the industrialized blocs are concerned, but the perpetuation of the willingness to go to war under nuclear threat in most of the world, including the citizens of those states whose leaders are best informed about the consequences of nuclear warfare, suggests that it is very difficult to convince people of the uselessness of dying for something that would no longer be embodied in other human beings.

Furthermore, the last ten years have demonstrated that, as the world is currently organized, the threat of nuclear warfare, and the accompanying relative immobilization of the great powers vis-à-vis each other, neither prevent the proliferation of other forms of warfare nor decrease the violence within national states that may become civil war. It is therefore necessary to distinguish between (1) the immediate consequences of the balance of terror, (2) the recognition that warfare on a world scale is not only no longer functional, as it has often been in the past, but actually endangers the entire population of the planet, and (3) the development of values that may in time make it easier to discard war as a political tool. We may also argue that the failure to use the invention of nuclear warfare as a sufficient condition for the establishment of international order after World War II was due to the absence of other necessary inventions and alternatives to the political-economic arrangements in this interconnected world.

Warfare depends upon the establishment of unequivocal and mutually exclusive identities and loyalties, today represented by national boundaries. As long as there exists the permanent definition of one's own group, within which to kill is murder, as opposed to groups whom it may be virtuous to risk one's life to kill, warfare or the threat of warfare with its accompaniment of uncontrolled violence among smaller nations, or subnational groups, can easily be invoked.

Various modifications of our present conceptions of the nation-state are possible. The present definition predicates the state upon its absolute right and continuing ability to make war on other states. This definition, supported by properly developed sanctions and accepted definitions, could be changed to an emphasis on nationhood in which the identity and power of each state are a function of the identity and power of all other nations, as is the case where federations succeed in blocking internal warfare and strengthening the security, well-being, and identity of each group as a function of its membership in the larger group. It is frequently argued that federations have been dependent upon external enemies and therefore are impractical forms to use as models for a single world order. But internal order has been attained by societies without the need of invoking external enemies, once social forms made possible the identification of all members as equally human and exempt from treatment as non-human. So slaves have been freed, children released from the brutal domination of parents and teachers, women given rights, and minorities given full citizenship, as social identifications have been altered in belief and in practice. If nations were defined as owing their status to the existence and prosperity of other nations, their security to the security of other nations, and if emphasis were placed upon interdependence rather than independence, concepts of nationhood could replace nationalism. Such changes in our present world organization would involve altering the appeal of nation-states. That is, we must find other ways to perform those organizational and identity-bestowing functions now met by nation-states. Substituting multilateral responsibilities for bilateral agreements is one way in which this change could be promoted. A second structural device would be the development of multinationality, but it seems unlikely that this would be adequate without further changes in international structures. But as long as nation-states are the building blocks of international structures, regional organization or nonlocalized power blocks will represent the weakness inherent in their component parts. Any component in an overarching structure designed to eliminate war must, by necessity, not make possible the total definition of members of another group as non-human and suitable for killing. International organizations built of nation-states, in whatever combination, are always liable to return to warfare. For this reason the simple federation model is not a feasible alternative.

If the model of a single hierarchical state is used to represent a possible future world community, we then have to reckon, not with the traditional view of warfare in which the enemy are defined as non-human, but with the cultural acceptance of the less ancient, but equally well-supported social belief in the rights of local, geographically based groups vis-à-vis superordinate groups governing larger territories. This belief, which those who think territoriality is so important trace to animal societies, is, however, also subject to man's capacity to symbolize. The intrinsic right to self-determination and autonomy of a localized group can easily be extended to non-localized groups conceived as more human—as against the less human or the non-human other. Religious groups have this capacity, and most of them have exercised it, and divisions along lines of racial identity, language, custom, and political ideologies have proven just as potent rallying points as geographical continuity. It is true that since the invention of the autonomous nation-state they have had to capture the state mechanism in order to actually make efficient, socially sanctioned war, so that the cultural appeals of mutually exclusive geographical and ideological identities reinforce each other. But a scrutiny of history suggests that the elimination of one without the other will not be sufficient. The present demand for a theology of revolution (World Conference on Church and Society, 1967) is only another form of the old demand for a theology of the divine right of kings and the legitimacy of wars between nation-states in which the priesthoods of the same religion could each pray for victory. Any form of world state within which the components can rearrange their loyalties so that members of other identifiable groups can be defined as legitimate prey—and so non-human—or as predators whom it is noble to fight and kill—and so non-human—cannot be regarded as a social invention that can actually prevent war. Ideas of revolution and holy wars would continue to threaten its stability, just as geographical loyalties would continue to threaten the federation model.

Our organizational task, then, may be defined as reducing the strength of *all* mutually exclusive loyalties, whether of nation, race, class, religion, or ideology, and constructing some quite different form of organization in which the memories and the organizational residues of these former exclusive loyalties cannot threaten the total structure. The difficulty of arriving at such a conception only attests to the dangerous hold of past models on our imagination.

One of the principal contributions of anthropology should be to distill from our available treasure house of small and unusual social models—many of them outside the single, narrow, and steadily converging mainstream of "civilization"—new combinations and new forms that will release us from our historically limited imaginations. The proposals I am going to make stem from a series of anthropological contributions to the subject of alternatives to war, in the specification of necessary conditions and the prefiguration of new forms (Malinowski, 1948). Ruth Benedict (1959) insisted upon the importance of institutional arrangements rather than human motives as the essential and modifiable elements in the consideration of warfare. Gregory Bateson (1936, 1948, 1949) brought warfare within the formulations of cybernetics, self-perpetuating systems, and positive feedback runaways, by combining Richardson's (1960) neglected theory of an armaments race with the emerging cross-disciplinary language of cybernatics (Foerster, 1950-56). Geoffrey Gorer (1949) has concentrated on the importance of developing smaller, crosscutting forms of group identification and on the relationships between ethology and discussions of warfare. Alvin Wolfe (1963) drew upon his anthropological training in identifying an emerging form of acephalous control, against which rebellion or revolt was impossible.

As a prelude to more specific suggestions that utilize all of these, I should like to discuss Alvin Wolfe's model in some detail. In his paper (1962) he identified the new form of control over minerals in Africa by overlapping membership of boards, which themselves had different geographical centers of influence; the mineral industry, with board memberships reaching from Brussels to San Francisco, and international agreements on the subject of the controlled production of industrial diamonds including Moscow, actually had superseded the power of either the former colonial powers or the national governments of emerging African states. He showed how this acephalous organization was one that could neither be joined nor resigned from, based as it was on overlapping membership in which no one membership could be seen as primarily related to the whole.

Another important point is that control broke down as the Belgian Union Minière tried to excise old forms of nationally-based exclusive power, and disorders in the Congo have been a continuing sequela.

Our new models for world organization can be asked to meet the following negative requirements:

1. Absence of forms of organization that provide any mutually exclusive self-identifications.
2. Absence of self-perpetuating, accelerating systems that involve positive feedback runaways.
3. Absence of the kind of hierarchical, linear, or branching structures in which the component units can be seen as of the same sort—and so opposed—or as presenting organizational lines of fission.

As positive requirements they should:

1. Provide order, as well as prevent major wars.
2. Provide for the distribution of the essentials and goods of life among all the peoples of the planet, such that their common and shared species membership is not violated and so accompanied by denial.

3. Distribute centers of power in organizational functions that will necessarily be worldwide, such as control of food, banking, communication, policing, travel and migration, and protection of the natural environment, so that no two coincide geographically and so that the structures expressing these functions are dissimilar in such dimensions as size, internal relationship between organizational levels, number of constitutent regions, etc., in order to reduce possibilities of symmetrical conflict among them. No one of these administrative structures should command other than professional loyalties.

4. Establish the conditions for self-identification with an initial, small, geographically located group, within which all the component individuals could be personally known, to underwrite each child's need for identity and security. These needs have been well spelled out (Erikson, 1963; Soddy, 1961).

5. Establish the conditions for a variety of mutually overlapping and non-exclusive identifications with larger groups of many kinds, without any single or overriding loyalty.

Finally there are conditions of order without which it would be impracticable to discuss such new worldwide arrangements. The non-fulfillment of these conditions might seriously prolong the present state of worldwide anarchy, small wars, and disorder. It will be necessary:

1. To continue to prevent nuclear war.

2. To establish adequate technological and political means to halt the rapid pollution and deterioration of the biosphere.

3. To establish the technology and the ethics to halt the present rate of population increase and restore it to a balance with food supplies and human resources of maturity and skill.

4. To increase food production without intensifying the present consequences in the destruction of the biosphere.

5. To establish a worldwide secondary spoken language that will equalize the positions of speakers of all languages, large and small (this means adopting a politically negligible natural language), and some form of glyphic and written communication that will be independent of lexicographic considerations, like Chinese, but more formal, simpler, and easier to learn and to execute (Benedict, 1948; Deutsch, 1966; Mead, 1948, 1963b, 1965; Mead and Metraux, 1965).

6. To find ways in which young males, in an increasingly urbanized environment, can validate their courage and physical competence as substitutes for the validations once provided by exacting natural environments and war, in order to prevent the consequences in urban violence that we are seeing all over the world today.

7. To find effective but non-lethal ways to control large masses of people.

We should, finally, build into all plans methods of assaying the unanticipated by-products of taking first steps in any given direction. Although general systems theory—the sophisticated successor of cybernetics—has provided us with both a cross-disciplinary and cross-ideological medium of communication, it has not been self-conscious enough in allowing for changes when it itself is applied. Our knowledge of biological behavior of all sorts, and particularly of human behavior, is so imperfect that long-term planning without allowance for multiple feedback often does more harm than good.

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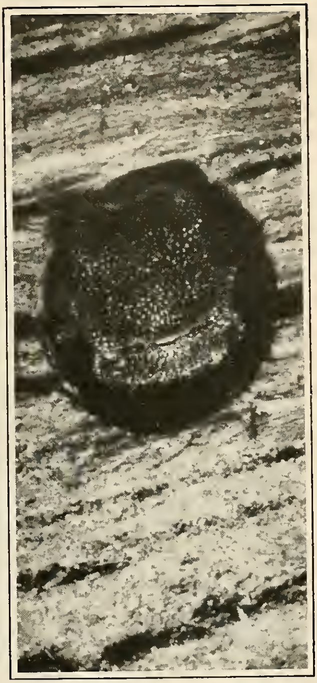
LIVING DOORS



by William S. Creighton

There are few animals that are free from predators, and the protective behavior that predation has brought about varies endlessly. In many animals the attack of the predator is held in check by counterattack on the part of its intended victim or, if this is impossible, by flight. Occasionally, the best protection is afforded if the intended victim neither fights nor runs. This is true of certain protective behavior shown by ants in which one member of the colony acts as a door to the nest.

The technical term for such activity is phragmosis, which literally means "the state of a hedge." This can be broadened to "the process of being a barrier." But, while the second version may be more understandable, it is a very partial definition of phragmosis. When an alert football guard blocks a quarterback sneak he has obviously been a barrier, for he has placed himself so that an oncoming opponent has not been able to get past him. But phragmosis is not involved here because the guard has operated actively and in the open. The definition of phragmosis demands that the blocker must do its job within a closely confining area and that it must be inactive if the blocking is to be successful. For the best results it should not be apparent that the blocker is there at all.

It follows that phragmosis is an unspectacular and passive business. The concealed nature of phragmosis is, in fact, one reason why it has been so little studied. We do not even have a proper term to apply to the individual who is performing the phragmosis. In ant colonies this function is restricted to the nest-founding female or the major worker (a large, wingless female without genital organs). Since the individual engaged in phragmosis must stand just within the entrance of the nest, it is often called a janitor. But an ant engaged in phragmosis is both the doorman *and* the door. Its responses determine who may enter and leave the nest, and its physical features are the basis on which this determination rests. An individual who is a door can function effectively only if it fits the doorframe; in the phragmotic ants the living doors have been altered by the processes of evolution to make them fit their frames with greater accuracy.

Most of what we know about phragmosis has been derived from a study of members of the genus *Cryptocerus* or of members of the subgenus *Colobopsis* in the genus *Camponotus*. Other ants practice this type of defense, but they are less well known. Structurally the two groups have virtually nothing in common. Since each belongs to a different subfamily it must be supposed that their phragmotic responses evolved independently and can only be considered together because the same end result is produced.

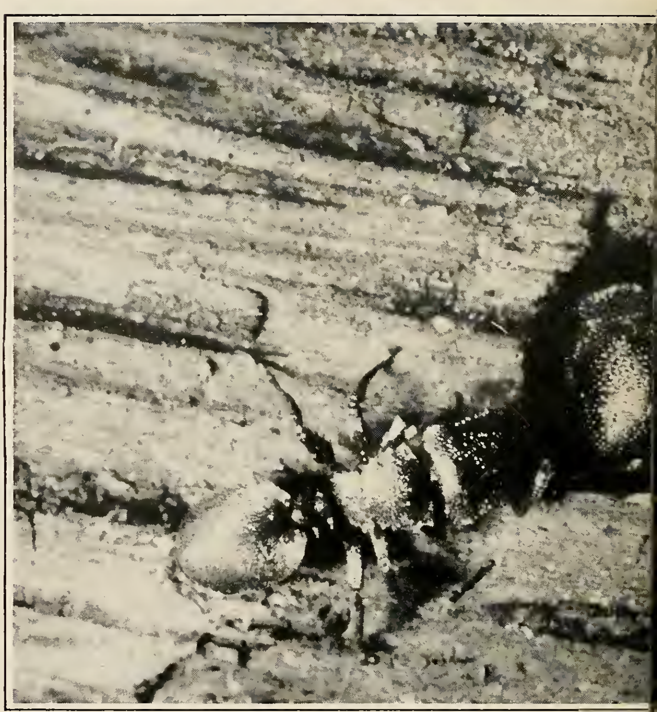
As far as is known at present, all members of *Cryptocerus* and *Colobopsis* nest in woody tissue. The connection between this and phragmosis should be clear if the nature of the doorframe is considered. The shape and size of any nest entrance constructed in soil is difficult to keep constant. Yet it is vital to a phragmotic ant that the nest entrance be of a constant shape and size if it is to be sealed by a living barrier. On this basis it would be expected that ground-dwelling ants would seldom practice phragmosis, and this is the case. One of the very few that do so is *Camponotus ulcerosus*. Although this species nests in soil it avoids the difficulty of a crumbling doorframe by constructing a carton shield—a paper-thin sheet of vegetable matter, cemented together with salivary secretions—with an opening of the proper size, above the opening in the soil. With tree-dwelling species, the situation is entirely different. Their nests may be set up in wood so hard and durable that there will be no appreciable change in the nest entrance during the life of the colony. It is interesting to note that in the southern United States and northern Mexico the nests of phragmotic ants are more often encountered in the extremely hard live oak trees than anywhere else.

If a nest-founding female of a phragmotic ant picks a live oak as a nest site, she will find that much of her work has already been done for her. The limbs of live oaks are extensively tunneled by the larvae of various wood-boring beetles. These usually construct unbranched passages several inches long, with a blind inner end where the larva pupates. After the beetle has become an adult, it then burrows a new and somewhat smaller tunnel to the surface of the branch, where it then exits. The operations of the beetle larvae result in the death of the limb in which they have been boring, and by the time the ant reaches the limb the bark has usually dropped off. The openings made by the beetles are then clearly visible. All that the nest-founding female has to do is to select one and back into it. She does not even need to clear the main passage of waste materials left by the larva, for the exit passage made by the beetle will accommodate her and her initial brood. Once the female has assumed an occluding posture at the mouth of the tunnel, the nest becomes virtually impregnable and nothing can get past the living door to destroy the eggs deeper in the tunnel. When the eggs hatch and the brood matures, the major workers take over the job of occlusion.

Having considered the doorframe, let us now look at the door. In this it is best to study the major worker rather than the female, for our knowledge of the worker's behavior is much more complete. It was originally supposed that the phragmotic patterns of *Cryptocerus* and *Colobopsis* were essentially the same, but as more data came to light, it has become clear that the two groups have quite different phragmotic behavior.

It is often said that the head of the major of *Colobopsis* is shaped like a cork. This is not quite true, for the smaller end of the "cork" is not circular in outline. But the simile calls attention to the fact that the larger end, consisting of the truncated part of the head and the mandibles, *is* almost perfectly circular. The diameter of this circle is somewhat greater than the maximum width or height of the thorax. It follows that if the major of *Colobopsis* holds its head so that the long axis of the head is parallel to that of the thorax the ant can, so to speak, hide behind the front of its own head. Moreover, if the major places the front of its head in a circular aperture whose diameter is slightly greater than that of the head, almost all of the space inside the aperture will be filled up. If the aperture is the nest entrance, this action will have effectively blocked admission to the nest of any intruder of significant size.

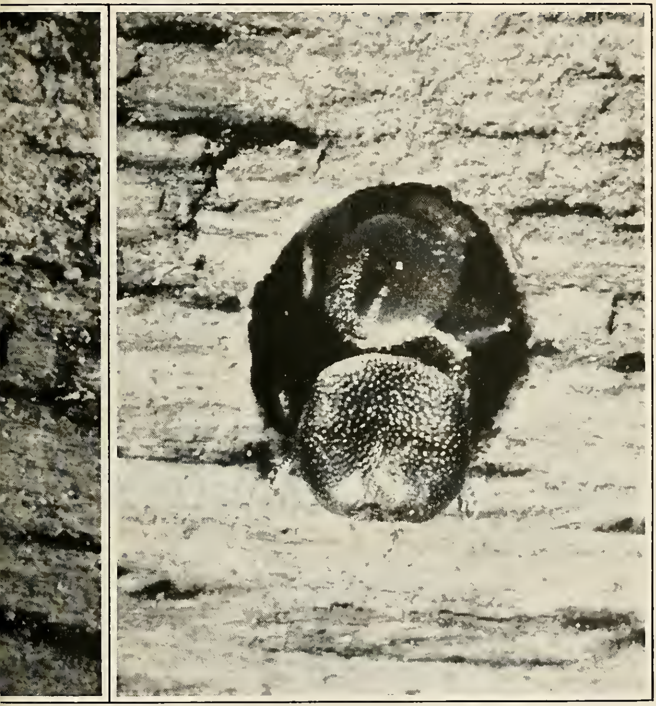
It should be understood that even with the best-fitting doorframe there is always a slight gap between the frame and the door. But this gap is so narrow that when the major is in the occluding position its head cannot be moved enough to create a passageway between its rim and that of the nest entrance. Therefore, when a minor worker of *Colobopsis* wishes to enter or leave the nest, the occluding major is forced to back down the passage to where it widens out enough to let the minor squeeze past. While the ant colony is actively foraging, the major of *Colobopsis* is constantly moving back from the nest entrance and returning to it as the minors pass in or out of the nest. But when there is no traffic the door remains closed.



A minor worker of Cryptocerus texanus *awaits admission at the nest entrance, which is blocked by the major worker. As a major crouches and moves forward, a space is opened, thereby permitting entry.*

None of this is true of the major of *Cryptocerus*. Its head has not the least resemblance to a cork. Seen from above its most prominent feature is the cephalic disk, a saucer-like oval area embracing most of the head and outlined by a conspicuous, flanged rim. At the rear of the head the occipital angles project beyond the disk like two triangular ears. Behind these is the anterior margin of a massive thorax, which is fully as wide as the head. With the head in its normal position the top of the thorax is well above the level of the rear border of the head. It is impossible for the major of *Cryptocerus* to use the cephalic disk as the major of *Colobopsis* uses the truncated surface of its head, for if the head of the *Cryptocerus* major is held with its long axis parallel to that of the thorax, the disk will be parallel to the roof of the nest passage. Instea the major worker uses the cephali disk in combination with the front o the thorax, which together form roughly oval barrier. The fit is no as good as it is with the *Colobopsi* major, but it is effective when use to block the oval nest entrance.

When it is in the occluding posi tion the head of the *Cryptoceru*



major slopes down from the thorax like the blade of a snowplow. As a rule the mandibles rest on the floor of the nest passage, just inside the entrance. When the minors wish to enter or leave the nest the major moves forward slightly and crouches. The forward movement brings the mandibles beyond the rim of the nest entrance, and when the major crouches, the front part of the head is depressed below the floor of the passage. At the same time the thorax is lowered enough to make a space between it and the roof of the passage. Through this space the minor passes. It sometimes happens that the major rises again before the minor has gone through the gap. When this occurs the minor is pinned between the major's thorax and the roof of the nest passage. Oddly enough, the major is usually in no hurry to release such minors, and they often stay trapped until the door opens again to admit another worker. Here the door is never completely out of the frame, even during periods of heavy traffic.

Thus, in these two genera the parts of the insect that make up the barrier are largely different, as are the reactions that allow the passage of minors past the barrier. The only feature shared by the phragmotic patterns of the two groups is the fact of occlusion itself. It would seem, therefore, that the important thing is not how the door is constructed nor how it is opened, but that it will remain shut when the occasion demands. Since the door is a living individual this calls for some unusual behavior. This can be best understood by showing how it differs from that of tree-dwelling ants that are not phragmotic.

Consider, as an example of one sort of behavior, the responses of *Pseudomyrmex belti*, which nests in the hollow spines of bull-horn acacia trees. The nest entrance consists of a single, small oval opening quite similar in size and shape to those found in the nests of phragmotic species. When a nest of *belti* is disturbed, its members rapidly stream out through the nest entrance and attack the intruder with highly painful stings. Thus, the protection of the *belti* colony consists of an active and aggressive response, which moves the ants away from the nest entrance. Another species, *Pseudomyrmex apache*, exhibits an avoidance reaction when the nest is threatened. It usually nests in the abandoned beetle burrows in live oak limbs. When the nest is threatened, the workers of *apache* ordinarily withdraw into the burrow to avoid confrontation with the intruder. Here again it should be observed that the response involved is an active one that removes the ants from the vicinity of the nest entrance.

It should now be clear why the behavior of an occluding major of a phragmotic ant is so remarkable—the ant shows no obvious response to danger stimuli that produce great activity in other ants. This does not mean that the major is doing nothing, for the door remains in the doorframe, blocking entry. On the basis of current views of insect behavior this response or, perhaps more accurately, this lack of response is entirely automatic. The ant cannot do other than remain passive. But one sometimes wonders if this view is not a little too rigid.

The major of *Camponotus ulcerosus*, mentioned earlier in this article, generally a perfectly passive door, may be used as an example. It blocks the aperture in its carton shield to perfection and remains in position without movement while other ants walk over its face, even workers of *Xiphomyrmex spinosus*, ants that make a habit of snatching food away from *ulcerosus* workers. Most of the time a worker of *spinosus* can walk across the face of the occluding *ulcerosus* major and cause no response. But occasionally the major, whose jaws are fully exposed, will forego its passivity, seize a *spinosus* worker, and snatch it into the nest. The major then resumes its blocking position while the other members of the colony finish off the trapped *spinosus* worker. At times it seems too bad that ants cannot smile.

Easter Island

Stark monuments and ruins that dot the landscape tell of a complex culture. which once flourished on this isolated Pacific island

by William Mulloy

On Easter Sunday, 1722, a Dutch explorer, Jacob Roggeveen, landed on a remote volcanic island some 2,200 miles west of the South American coast. There, on the easternmost island of Polynesia, which he named Easter Island, the Dutchman found an advanced society suffering from violent internal conflict. its people living to a considerable extent among the ruins of their former spectacular achievements. Monumental stone statues had been pushed from their pedestals and lay broken, while the island inhabitants hid from one another in caves. Roggeveen was no doubt impressed by the huge sculptures and the other signs of an advanced civilization, but. like other European explorers who later visited Easter Island, he did not feel that the place had much economic potential and consequently assigned it no significance in his log.

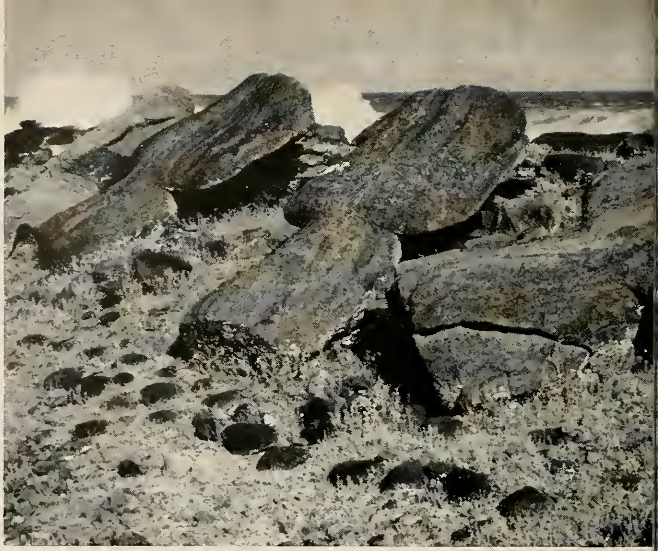
So Easter Island, now well known for its gigantic, brooding statues, and for the mystery surrounding the origin and growth of its complex culture, was largely ignored for almost one hundred years. Then, in 1805 the schooner *Nancy*, out of New London, Connecticut, carried away twenty-two islanders for use as slaves, and the Western world realized that the island had economic possibilities that appealed to its value system. With time, the slave raids increased, and between 1859 and 1862, Peruvian raiders carried off about one thousand people to work at guano mining off the coast of Peru. As a result of a protest lodged by the Bishop of Tahiti, the few survivors of this crime were returned to Easter Island. But the returning islanders had contracted smallpox, and the introduction of this disease to the island all but annihilated the remaining inhabitants. Thus, the once high Easter Island culture, already torn by internal warfare, was dealt a death blow by the slave raids. In 1877, a visiting Frenchman reported that only 111 islanders remained.

While the population of Easter Island has now increased to about a thousand individuals, the cultural collapse took with it most of the clues for answering a question of considerable importance to anthropology: How, on this remote ocean-bound island, had such an advanced society developed in the first place?

An elementary principle of culture growth, documented by countless examples, states that culture is largely a product of idea swapping. Complex civilizations have developed where large populations had outside contacts, and where advantage could be taken of ideas invented elsewhere. It is no accident that the first civilizations developed in southwestern Asia where Africa, Asia, and Europe meet. Conversely, the ultimate simplicity of human life is seen at the ends of the earth among such people as the Alacaluf and the Yahgan of Tierra del Fuego, the Bushmen of the Kalahari Desert, and the Tasmanians. These small groups live where foreign contacts have been rare and the flow of ideas sharply restricted.

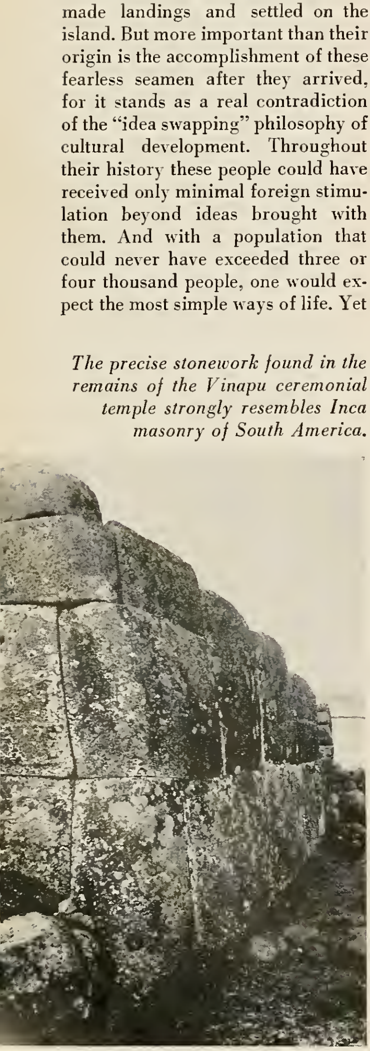
Easter Island is one of the more isolated localities of the world. Surrounded by the sea, it is outside the

Seven statues, each weighing about sixteen tons, gaze from the restored altar of Ahu Akivi.



During the internal warfare that wracked the small island, stone statues were toppled and smashed to destroy their supernatural power.

range, so far as we know, of systematic two-way Polynesian voyages. It was probably discovered several times by lost wanderers who could not return to their original homes. Although most of the culture, including the language, seems to be Polynesian, a few traits strongly suggest that American Indians may have made landings and settled on the island. But more important than their origin is the accomplishment of these fearless seamen after they arrived, for it stands as a real contradiction of the "idea swapping" philosophy of cultural development. Throughout their history these people could have received only minimal foreign stimulation beyond ideas brought with them. And with a population that could never have exceeded three or four thousand people, one would expect the most simple ways of life. Yet we find such hallmarks of cultural complexity as written texts not known to be related to any foreign script, a political structure capable of planning and co-ordinating public works, an organized priesthood, and a sophisticated interest in such celestial phenomena as the equinoxes and the solstices. In addition the islanders developed a remarkable religious building compulsion, which resulted in about a thousand statues, some of which weigh hundreds of tons, in addition to numerous other religious structures. All this on so small and remote an island understandably evokes genuine astonishment.



The precise stonework found in the remains of the Vinapu ceremonial temple strongly resembles Inca masonry of South America.

A reliable radiocarbon date of A.D. 857, ± 200 years, indicates that a human population had already arrived on the island during the ninth century. Since this date was obtained from a large statue-bearing altar unlikely to have been built among the first activities of new arrivals, it is probable that initial discovery occurred much earlier. The first immigrants certainly devoted many years exclusively to such basic problems as the development of food and shelter sources. Their economy was based on fishing and the cultivation of such crops as sweet potatoes, yams, bananas, sugar cane, taro, gourds, and the paper mulberry so useful for making tapa cloth. It is not known which of these were brought by the first migrants, but all were in use at the time of first European contact. The chicken and the *kioe,* or Polynesian rat, were also present and used fo food. The relative ease with which food crops can now be grown best explains the rapid development of what was to become by far the most spectacular religious building compulsion in all of Polynesia. This required an economy that permitted a good deal of leisure.

The scattered distribution of the religious structures indicates that the people were widely dispersed along the coasts and adjacent interior areas. Local traditions relate that the population was divided into semi-independent kin groups of some sort. Each group seems to have had one or more religious structures, usually large open-air altars. These were variants of the well-known Polynesian marae, locally called *ahu.* Although they varied greatly, the typical form was a narrow dry masonry platform, at times as much as 650 fee long and 16 feet high, which sometimes had an elevated central section and lateral wings. This platform usually had a sloping paved ramp buil against one side. An artificially flattened plaza, where religious ceremonies were held, frequently face the ramp. Beyond this was a row o long, narrow houses shaped like overturned canoes, where, according t tradition, members of the priesthoo lived. These had thatched roofs an

oundations of large, precisely cut nd fitted basalt blocks, which sup- orted the superstructure. En- rances were lateral and opened on a rescent-shaped area paved with arge, rounded beach boulders, which ormed a kind of porch. Some *ahu* latforms were of relatively crude un- ut masonry, while others had gigan- ic blocks precisely cut and fitted in technique strongly reminiscent of nca masonry. Most *ahu* lay near hores with plazas on the inland side. 'arther inland were domestic estab- ishments and cultivated lands.

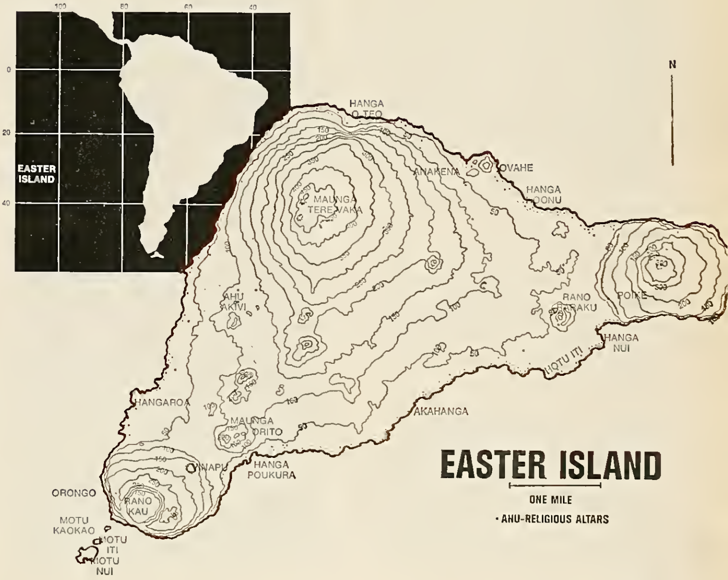
We do not know whether or not the arliest of the *ahu* had statues on heir platforms, but at some point in heir history statues began to be laced on them, singly or in rows, acing toward the plazas and thus sually away from the sea. Through ime they increased in size and styli- ation until a highly uniform type de- eloped. The classic statue reveals a uman figure from the hips upward, ith a protruding abdomen, arms eld stiffly at the sides, and hands un- aturally turned toward each other. Heads are elongated, with pursed ips and prominent, usually slightly oncave noses. Earlobes are extended nd often carved to represent in- erted earspools. Sometimes, large ylindrical headpieces, or topknots, nade of separate stones were added. Some, perhaps all, statues were painted in several colors. Tradition relates that statues represented ancestors and had supernatural power.

Within this general conception, *ahu* ruins vary greatly in size and individual characteristics. Many have been rebuilt several times; innovations have been added; usually size and height have increased. Perhaps competition among kin groups produced the impressive structures. It is likely that size and ostentation of features increased with the numbers of the groups that owned them.

Although some statues were of stone obtained in a variety of locations, it would seem that early in the statue-building period a single source became dominant. This was the tuff from the interior and exterior south slope of the volcanic cone of Rano Raraku in the southeastern part of the island. Here intensive quarrying was done, with statues being completely carved while still attached to the rock. When detached they were lowered down the side of the volcano on their backs. Some were initially slid into prepared holes near the base of the talus and erected in these. Here more than seventy still remain, of which the tallest is 37 feet high. Nearby are about thirty others lying mostly prone. These may have been tipped forward out of their holes in preparation for movement to *ahu* in other locations. Many others, presumably in the process of transportation, lie along roads in various parts of the island. Remains of extensive quarrying operations are also found above the talus slope, where at least two hundred statues can be seen in every stage of preparation.

Everywhere in the quarry are the discarded basalt chisels or picks that were used in carving. Some might have been laid down on the day quarrying ceased. The number of statues in various stages of completion suggests that many crews worked at the same time. It is not known whether each *ahu*-owning community sent its own representatives or whether the carving was in the hands of specialists, but in any event, a large proportion of the island's small population must have engaged in one or another aspect of the statue-building labor, judging from the amount of work that can now be found.

The largest statue known to have been moved to an *ahu* is almost 32



feet long and weighs about 90 tons—a formidable transportation problem, even in 1967. On some sort of sledge and with enough men such a statue might have been pulled by brute force. More ingenious methods were probably used, but we do not have unequivocal evidence as to what they were. Islanders have a simpler explanation—the statues walked to the *ahu* with the aid of magic.

The problem of erecting the statues on the *ahu* also required engineering skill. It is highly probable that statues were levered up in stages while a platform of stones and earth was gradually built under them. This platform was elevated toward the head until the statue could be tipped into place. In 1955, a statue about 16 feet high, weighing close to 27 tons, was re-erected in this way by Pedro Atan, an Easter Islander. Atan said he had been told of the method by his grandfather and the latter's brother-in-law. In 1960, seven somewhat smaller statues were similarly re-erected as part of the restoration of *Ahu Akivi.*

The previously mentioned cylindrical topknots were carved from red scoria, which contrasted sharply with the gray tuff of the statues themselves. The scoria was obtained from a quarry at the volcanic cone of Punapau near the west coast. The quarry is much smaller than the one at Rano Raraku, which suggests that the idea of the headpieces was conceived rather late in the statue-building period. Like the statues, the topknots were carved in place and rolled to their *ahu* locations. Some of these weighed over 10 tons, and raising them in such a manner that they would remain in position and not topple the statue required a combination of delicate manipulation and brute force. Probably they were placed at the statue heads while the latter were still horizontal, and raised on an extension of the same earth and stone platform.

At the southwestern corner of the island lies the village of Orongo, which occupies a spectacular location on the narrow-crested western lip of the crater of Rano Kau. To the west is a steep cliff descending more than 800 feet to the sea where lie the three islets called Motu Nui, Motu Iti, and Motu Kaokao. On the east an almost equally steep slope descends some 650 feet to the almost mile-wide crater lake of Rano Kau, which is covered by a varicolored mat of totora reeds solid enough to walk on—a hauntingly beautiful setting.

Formerly, Orongo was occupied during part of each September by representatives of the various kin groups. A ceremony was held that involved, among other things, a contest in which the participants descended the cliff and swam to the islet of Motu Nui about a mile offshore. The first to bring back an egg of the *manutara,* or Sooty Tern, was declared winner. His sponsor became *tangata manu,* or bird man, and occupied a position of special ceremonial importance during the following year.

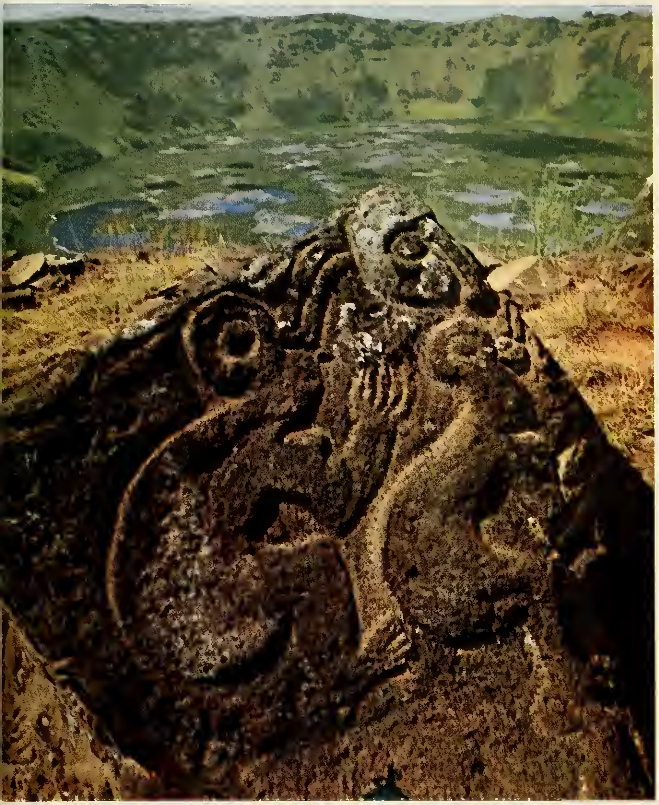
Orongo is the site of about 47 houses, which are constructed differently from those found elsewhere on the island. The typical form is a narrow ellipse with walls made principally of thin stone slabs. Large roof slabs are carefully corbeled and interlocked to join at the center. Most houses are built into slopes so that one side is below ground level.

South of the village an extensive area of basalt outcroppings is beautifully decorated with large, excellently executed petroglyphs done in high relief. Many figures of the *tangata manu* (man wearing a bird mask) commemorate the egg race winner's sponsor, and others depict a local god called *Makemake.* The one small *ahu* at Orongo has a kind of sundial which marks the position of the rising sun at the equinoxes and summer and winter solstices. Ceremonies were held here as late as 1866 or 1867, and we have more complete information about these events than of those associated with the *ahu.*

Although *ahu,* statues, quarries, and the village of Orongo are among the better-known ruins, there are many other monuments and examples of architectural excellence, artistic accomplishment, and engineering skill. These range from elevated tombs and crematoriums to circular, clustered enclosures in which paper mulberry was grown; from the hundreds of conical towers that marked the boundaries of land owned by adjoining groups to the masonry-lined caves that were used as residences and refuges from hostile kin groups. Scattered throughout the island are the remains of thatched dwellings and masonry chicken coops erected during prehistoric times. The house of the common man was simpler than that of the priest and was usually located inland, adjoining agricultural areas.

Taken as a whole these and many other structural remains tell of an industrious population with a prosperous economy capable of producing significant amounts of leisure, which could be devoted to time-consuming religious endeavors. This architectural and artistic activity reached its zenith about 1680, at a time shortly before the first historic contacts, when the available land supported an optimum population and the economy had developed its greatest productivity. These factors contributed to maximum organization and made it possible for Easter Islanders to produce a remarkable quantity of religious statuary and architecture.

But an effective equilibrium between population and resources rarely lasts long in any culture, and this one was no exception. Perhaps in the fate of the inhabitants of Easter Island we see a preview in microcosm of what may ultimately be the fate of the whole of mankind. The land and resources of the island were sharply finite, and here the line between optimum population and overpopulation was a thin one indeed. It seems likely that this balance began to deteriorate shortly before the first European contacts, because of overpopulation that resulted in competition for agricultural land and fishing rights. Although ritual cannibalism may have been present earlier, it appears to have become a more practical matter once population pressure became intense. The groups carving statues at Rano Raraku were probably no longer safe and work at the quarries ceased. The extensive unfinished work and the tools lying at hand give the impression that labor there halted suddenly. Perhaps all the workers fled to the protection of their kinsmen on a single day, thus termi-



nating a stoneworking tradition that had taken centuries to develop.

One of the characteristic goals of the ensuing warfare was the overthrowing of statues of enemy groups and destruction of their *ahu*. Possibly the ten or so kin groups, driven by hunger and desperation, attacked each other's monuments to destroy their enemies' source of supernatural power. Excavations were dug under the statue pedestals, and as the figures crashed down, the red scoria topknots rolled many yards inland. Sometimes, basalt slabs were carefully set on edge in front of the statues so that when they fell they were sure to break across the neck, and could not be erected again. The islanders still tell with intense emotion of defeated people hiding in caves who were hunted down and eaten by the victors. Once the older leaders and the priests lost their power, and their lives, all vestiges of order and security vanished. Many people sought the protection of the *matatoa*, the strongest of the island's warriors. Predatory bands appeared. This warfare may have lasted for more than one hundred and fifty years (from about 1680 to 1860), with some groups able to maintain their religious structures and organization intact much longer than others. It continued until well after European contact, for as late as 1838 a visitor reported nine statues still standing on two *ahu* on the west coast. There are no reports of statues standing on *ahu* after this time. The only ones to be seen today are the previously mentioned eight, which have been re-erected in modern times.

Petroglyphs of dancing "bird men" are located at the village of Orongo, near the crater of the volcano Rano Kau (background). In the quarry at Rano Raraku, stone statues were carved while still attached to the underlying rock (below). They were then cut loose, lowered down the slope, and transported to other locations throughout the island.

Warfare brought a serious cultural decline. While evidence suggests that the dead were once cremated, after warfare began, many stone-lined tombs were built among the fallen statues and in the ramps and platforms of the destroyed *ahu*. Other cadavers were simply laid out on the ramps and among fallen statues and covered with stones. As a result, many destroyed *ahu* were almost entirely covered with stones so that few vestiges of their formerly impressive masonry and architectural characteristics remain visible. Some took on the appearance of long, sloping piles of stone. New *ahu* were built of easily piled small stones in new locations, apparently to provide additional burial places.

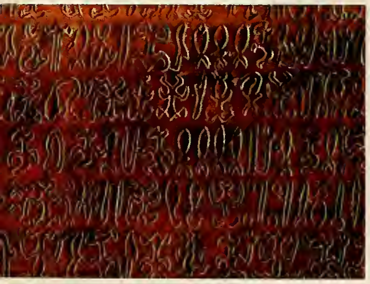
Upon this chaotic scene was superimposed the attention of the New World slavers and whalers, who harassed the Easter Islanders for an additional two-thirds of a century and who wrote the final page in the history of the culture's destruction. It was during this period that vast amounts of knowledge concerning the history and culture of Easter Island were forever lost—information that would have made clear the meaning of much that is enigmatic in the island's maze of ruins. The few people left could maintain little of the complex culture of earlier times. Most of it was soon forgotten. All of the priests who could read the script engraved on thousands of wooden tablets died as a result of the slave raids. When systematic attempts were made to find local people who could read the tablets, the stunning discovery was made that none were left. The unique Easter Island written language was lost, and despite nearly a century of effort by several highly trained linguists, the few surviving wooden tablets remain undeciphered.

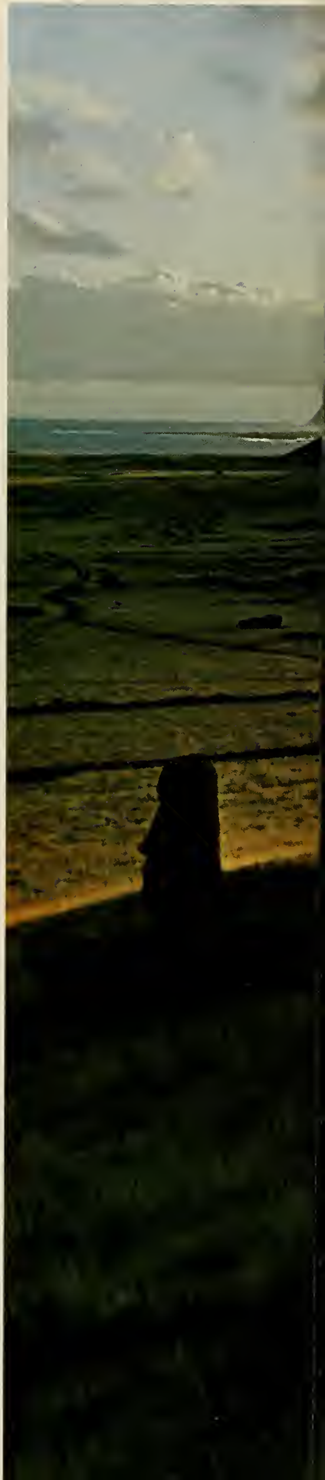
Thus, when Lay Brother Eugéne Eyraud of the Congregation des Sacres Cóeurs de Picipus arrived in 1864 he found a remnant population, which had lost its priesthood and most of the concepts that formed its older religion. He noted little or no religious practice of any kind among them. Although he experienced difficulties with the islanders, who stole his supplies and treated him badly, he persisted with missionary zeal and established the first permanent European settlement in 1866. Within the next few years the islanders were converted to the Catholic faith and remain Catholic to this day.

Soon afterward, outside influences began their slow intrusion, but the island was again "forgotten" by the Western world until the Norwegian archeologist Thor Heyerdahl refocused world attention on it with his popular book *Aku Aku*. Subsequently, it has become evident that Easter Island is a remarkable monument to human capacity—a unique example of what can be accomplished by a tiny group of people forced to build their lives with a minimum of outside stimulation.

Increasing attention has been devoted to the preservation of monuments and to further investigation of the island's anthropological significance. Islanders are proud of their heritage, and are apparently happy to see the influx of tourists resulting from recent interest in the island as an outstanding example of achievement in isolation.

Ten years ago, an average of only two ships per year visited this Pacific outpost. Today, the first of several planned hotels is already under construction. An airstrip was recently completed and a regular schedule of tourist flights is in operation. It seems that the islanders' long isolation is at an end and that in the twentieth century they are to become a part of the world community. It is to be devoutly hoped that they will find minimal cause for regret.





Nearly completed statues stand on the slopes of Rano Raraku, where they were abandoned at the onset of Easter Island's internal warfare (right). Then, slave raids of the nineteenth century destroyed the only islanders who had knowledge of the written language. As a result of this loss, the script, carved into wooden tablets (left), remains undeciphered.

When Will We *Change the Weather?*

Man is trying to kill hurricanes, cure droughts, suppress lightning; he even dares hope to change the outdoor temperature. The author, a leading researcher in weather control, reviews the progress and explains the remaining problems

by Bernard Vonnegut

Much has happened since Benjamin Franklin invented the lightning rod. It was perhaps the first scientific control over an atmospheric phenomenon, and certainly was dramatically successful. Here was a simple device—merely a good metallic conductor of electricity. Through it the electric charge generated by the thundercloud was led down harmlessly into the earth. This prevented damage to a building and death to its occupants. It tamed the thunderbolt.

It was also the starting point for many other attempts to control weather phenomena. Cannon were fired at waterspouts to break them up; rockets and artillery shells were hurled at clouds in hopes of provoking rain. Metallic points were set up in vineyards in the hope that electrical discharges from them would prevent the formation of hail and save the grape crop. Other attempts used electricity for producing rainfall. One way flew balloons tethered to metallic conductors that released electricity into the air. Another sent up aircraft to release electrified sand particles into the clouds.

Some of these methods were based on sound scientific principles and may succeed some day. But potentially useful or not, the results were discouraging. In view of the staggering amount of energy involved in weather phenomena, and the discouragingly great area covered by a weather system, most scientists came to believe it almost axiomatic that any attempt to influence the weather was doomed to fail. They surrendered such hopes as directing a storm away from an already flooded area and sending it to a region threatened with drought; they abandoned their ideas of abating tornadoes and hurricanes, or steering these storms to where they could do no harm.

But just as weather is changeable, so is the climate of scientific thinking. We now see more clearly the difference between what should be possible and what we can actually hope to accomplish. In principle, we should be able to control the weather outdoors just as we do indoors, by heating, cooling, humidifying, or dehumidifying. But in practice, because the energies we command are puny compared with those of nature and because of the enormous equipment that would be needed, the cost of this kind of weather control would far outweigh its benefits.

Therefore, when scientists began to study the atmosphere intensively, they soon recognized two requirements for any effective control of the weather phenomena. They would have to employ methods that were more subtle and less expensive. And they would have to learn to guide or modify processes that already were taking place naturally.

The new attitude led to more knowledge about the physics of clouds. In particular, when the atmosphere was explored with new tools—balloons and airplanes—a few scientists realized that there are large-scale instabilities in the atmosphere, and that these might supply a way to control weather. The phenomenon of supercooling is such an instability.

A dramatic example came in 1927, when as Lindbergh flew over the Atlantic, his airplane experienced icing. This showed that the atmosphere often contains large volumes of clouds consisting of small supercooled water droplets that have not yet frozen even at temperatures well below 0°C.—the temperature we commonly but erroneously call the "freezing point" of water. In Lindbergh's case it was contact with his "Spirit of St. Louis" that caused the droplets to freeze.

Since then, we have become very familiar with supercooling. Its importance in weather processes was first recognized by the Swedish scientist Tor Bergeron, who showed that if small ice crystals did form somehow in supercooled clouds, they would rapidly grow at the expense of the supercooled water drops and start falling as snow; and if this snow encountered warm air, it would melt to form rain. W. Findeisen, a German scientist, then proceeded from Bergeron's theory to state that "in time, human science will be enabled to effect an artificial control on the course of meteorological phenomena. It can be boldly stated that at comparatively moderate expense, it will, in time, be possible to bring about rain by scientific means, to obviate the danger of icing, and to prevent the formation of hailstorms."

As we shall see later, the world still awaits complete fulfillment of that prediction. But only eight years after Findeisen's statement, his words were turned into much more than mere prophesy by Vincent J. Schaefer, a scientist at the General Electric Research Laboratory. His basic scientific discoveries led him to develop cloud seeding, a technique that made it possible for man to transform, at will, large volumes of supercooled clouds into ice crystals.

What Schaefer discovered with the supercooled clouds he created artificially in his laboratory's cold box—an ordinary home freezer—was that

Man-made cloud: water vapor in the clear, supersaturated air above a warm pond at Yellowstone Park is cold enough to freeze but doesn't—the air is too pure. Then the man lights a match. Water vapor quickly condenses around particles of smoke to produce tiny water droplets.

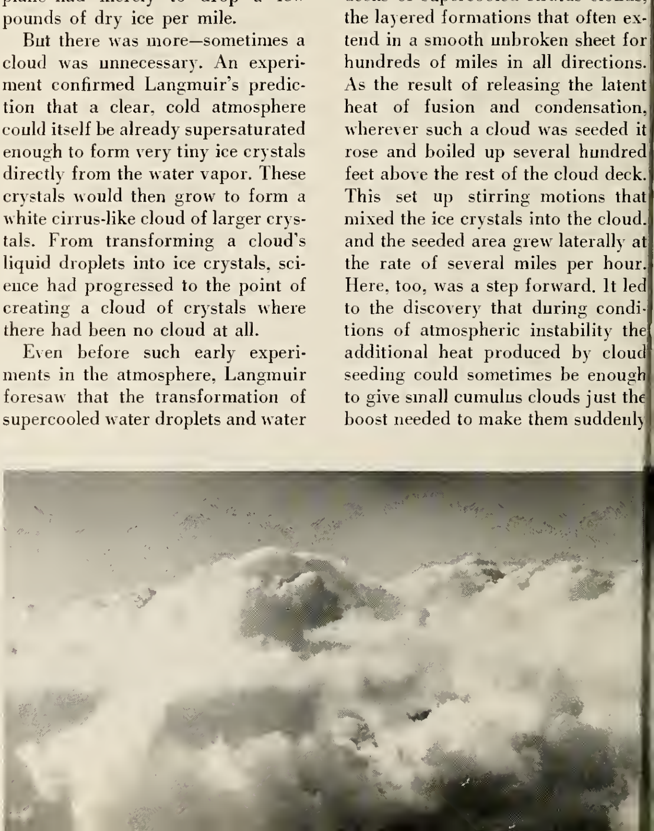
enormous numbers of ice crystals could be produced if only a tiny piece of dry ice (frozen carbon dioxide), or in fact anything colder than about –40° C., was introduced into such clouds. He and his laboratory associate Irving Langmuir (who had already won the Nobel prize in chemistry) calculated on the basis of the laboratory experiments that just a small amount of pulverized dry ice should be sufficient to transform a natural supercooled cloud into crystals of frozen water. On November 13, 1946, Schaefer tried this from an airplane. He dropped a few pounds of crushed dry ice into a supercooled cloud over Mount Greylock, Massachusetts. Within a few minutes after this "seeding," the cloud, which was several miles long, had been transformed from small water droplets into small ice crystals.

Langmuir once remarked that a scientific discovery is much like unearthing the corner of a buried treasure chest. If the discovery is valid, its general features will quickly emerge—just as the treasure chest, once located, will soon disclose its dimensions and contents.

Such was the case with cloud seeding. Successful experiments were soon performed with large areas, for example when an airplane flew over a supercooled cloud deck, seeding a "racetrack" pattern forty miles in circumference. To show results the plane had merely to drop a few pounds of dry ice per mile.

But there was more—sometimes a cloud was unnecessary. An experiment confirmed Langmuir's prediction that a clear, cold atmosphere could itself be already supersaturated enough to form very tiny ice crystals directly from the water vapor. These crystals would then grow to form a white cirrus-like cloud of larger crystals. From transforming a cloud's liquid droplets into ice crystals, science had progressed to the point of creating a cloud of crystals where there had been no cloud at all.

Even before such early experiments in the atmosphere, Langmuir foresaw that the transformation of supercooled water droplets and water vapor into ice crystals should release significant amounts of heat, the underlying principle being that ice needs heat to melt but water gives off heat when it freezes. His calculations of the extent of this effect were confirmed quantitatively by seeding decks of supercooled stratus clouds, the layered formations that often extend in a smooth unbroken sheet for hundreds of miles in all directions. As the result of releasing the latent heat of fusion and condensation, wherever such a cloud was seeded it rose and boiled up several hundred feet above the rest of the cloud deck. This set up stirring motions that mixed the ice crystals into the cloud, and the seeded area grew laterally at the rate of several miles per hour. Here, too, was a step forward. It led to the discovery that during conditions of atmospheric instability the additional heat produced by cloud seeding could sometimes be enough to give small cumulus clouds just the boost needed to make them suddenly



puff out greatly and even become thunderstorms.

Meanwhile, another avenue for seeding was being explored. The purpose was to learn if crystallization could be started merely by introducing particles of a foreign substance, instead of providing localized temperatures of around —40° C. A wide range of smokes, dusts, and other foreign particles were tried, but without effect. I then found that microscopic particles of certain compounds such as lead iodide and silver iodide did work very well, apparently because their own crystal structures closely resemble ice in the arrangement and spacing of their component atoms.

From this finding came the idea of heating silver iodide with a flame to form a smoke, which would then be carried into the atmosphere by natural winds and updrafts. With such "iodide generators" it turned out that a few ounces of iodide supplied enough nucleating particles to cause the formation of ice crystals in many cubic miles of supercooled cloud.

The iodide particles were only 100 angstroms in diameter. When something so small initiates the formation of an ice particle that then becomes a snow crystal, the growth ratio beggars the familiar illustration of an acorn growing into an oak. If we consider the iodide particle to be the size of a pea, the resulting snow crystal would be a hexagonal structure as large as the Pentagon building. Furthermore, this method of cloud seeding does away with the need for dropping the seed directly into the clouds. The seeding can be done wholesale by sending up enormous numbers of nucleating particles from seeding generators on the ground.

The early experiments, and all that have followed, show beyond any shadow of doubt that cloud seeding works, and works every time. It transforms supercooled clouds into ice crystals. This has a big effect on the cloud; it causes changes in such variables as the temperature, the circulation, the humidity, and the optical characteristics of the cloud. Even the early experiments showed conclusively that cloud seeding could open holes in supercooled stratiform clouds; it could produce snow or rain; it could dissipate supercooled ground fogs. But those changes brought by seeding were so simple and represented such a marked departure from the behavior of the untreated part of the cloud that the results were easy to see and easy to interpret. It is when attempts are made to modify larger and more complicated systems that understanding the results of experiments becomes difficult indeed.

The problem boils down to this. If we are to recognize the effects from any method of weather control, such as cloud seeding, we must first have a good idea of what would have happened without seeding. And that is very difficult because weather forecasts often fail to tell in sufficient detail what will happen "naturally" to large clouds and to storm systems. Would the rain have come anyway? Would the fog have disappeared without human intervention? Would the storm system have developed, collapsed, or, as hurricanes frequently do, roared off in another direction? The best that scientists have been able to do is repeat one experimental seeding after another, assemble the large amount of data, and try to figure out statistically whether it was the seeding that brought results.

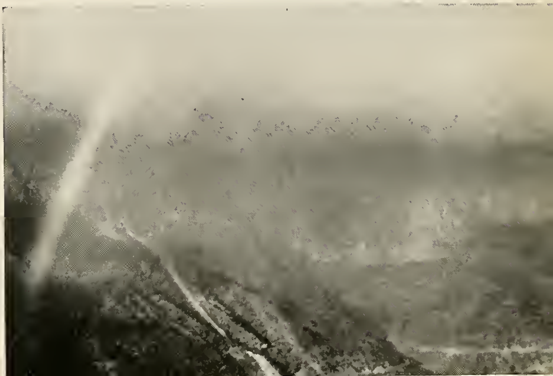
In some situations, such as when seeding thin layers of stratiform clouds, the treatment definitely increases precipitation by causing snow to fall. Under other conditions the precipitation may be reduced. For instance, consider one of nature's most efficient rain-making processes. It takes place when a cloud's water droplets come together and coalesce to make raindrops, which fall to the earth as rain at velocities ten times faster than the rate of fall of ice crystals. Obviously, seeding could interfere with or even prevent this much more efficient process.

There are further complications. Under some conditions seeding can cause large cumulus clouds to produce vast quantities of ice crystals that drift downwind and remain in the atmosphere. By doing so they reduce the amount of sunlight that falls on the ground. Such loss of solar heating can take place over very large areas and thereby prevent the development of other clouds that might yield great quantities of rain.

Obviously, then, as with all human pursuits, there is doubtless a right way and a wrong way to control weather by seeding. Depending on the conditions, it is possible to seed too early or too late, in the right place or the wrong place, and too little or too much.

It is also clear that because of the difficulty, expense, and time involved in analyzing the results of weather-

From cloud to rainbow: airplane will seed half of cloud towering at far left; 18 minutes after seeding, center, untreated half is unchanged, the rest has become broad, typically fuzzy area of ice crystals; beneath seeded part, below, rainbow is shown arching alongside rainfall.



modification experiments, we cannot expect great progress overnight. Experiments have had to be limited in scope and objective, and have tried only to increase precipitation or perhaps dispel supercooled fogs over rather limited areas, such as airports. Valuable though such weather modification may be, it pales by comparison with the advantages of being able to steer or to modify large-scale weather systems. It is when we learn to do this that we should be able to divert large storm systems from potential areas of flooding and direct them toward areas threatened by drought; to really tame lightning and smash a hurricane.

Already we have begun taking steps toward the large-scale control of weather. As far back as the early 1950's, Langmuir directed an experiment in which silver iodide seeding was done once a week in New Mexico to see if it would be possible to impose such a periodicity on the weather downwind. To the astonishment of all, including Langmuir, a strong weekly pattern developed not only immediately downwind of the seeded area but through almost two-thirds of the nation. Over vast areas, week after week, it rained once weekly on the same day, and on other days the weather was fair. Whether these results were merely a fluke or really a result of the seeding is still debated among scientists. Here is an unfinished bit of research that must one day be continued.

Also unfinished business, but receiving more attention, is the challenge to suppress the hurricanes (called typhoons in the Orient) that annually bring havoc and widespread alarm. Even if man could do no more than partly modify the behavior of these widely rotating tropical storms, the possibility is one that cannot be neglected.

Here we are dealing with the energy drawn from a convective overturning of the atmosphere. Warm, moist air from tropical seas spirals toward the core, the calm "eye," of the hurricane. This air, already turning slowly with the rotation of the earth, gathers speed as it nears the storm center, accounting for the destructive winds. Before reaching the center, however, it begins moving upward and away through a relatively small cloud "chimney" that serves as the storm's major energy cell—it is the connection between the inflow and outflow of air.

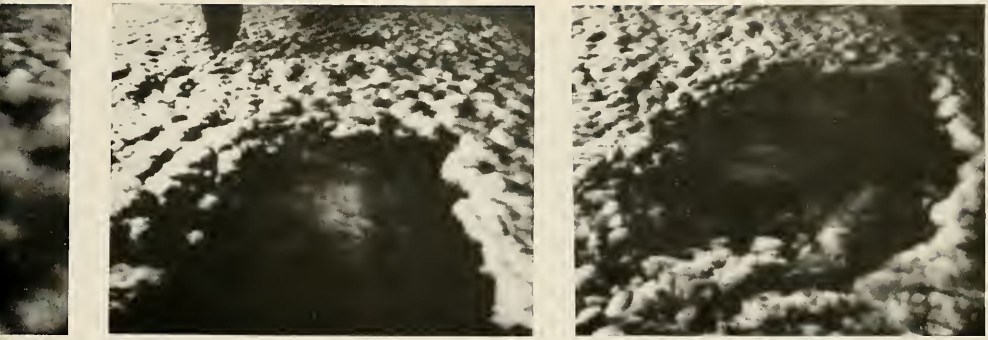
The idea of modifying such storms is based on what I have already mentioned: converting a cloud's liquid particles to ice will suddenly release latent heat of fusion; and this in turn may disrupt the storm's neat energy pattern. Seeding experiments along this line were first carried out under Langmuir's direction. As part of Project Stormfury they have continued in recent years under auspices of ESSA (the government's Environmental Science Services Administration). They have been inconclusive so far; when seeding the hurricane is accompanied by a weakening of its intensity, we cannot be sure whether this was caused by silver iodide crystals or natural processes. But we go on hoping that further experiments will reveal ways to break up a hurricane, lessen its severity, or at least steer it away from land.

Beneficial though weather control may be, we must be realistic. It cannot provide the answers to some of our more pressing problems. For example, there is little hope that any form of weather control will provide an answer to the polluting gases and particles we are releasing into the atmosphere. Another example: we may reasonably hope to see weather modification increase the global production of food, but it is hopeless to expect that this increase will match the rate at which population is increasing. At best, weather modification may perhaps provide a few more years in which to cope with this urgent problem.

At present, the most widely used and most promising modification technique is unquestionably the seeding of supercooled clouds with dry ice, silver iodide, etc., to cause or increase precipitation. The final report of the committee of the National Academy of Sciences dealing with weather control is largely devoted to techniques for increasing rainfall by this method, and to the encouraging results from some of the efforts.

But cloud seeding can also be exploited for other purposes. Though it cannot yet guarantee rain where and when wanted, we do know it affects cloud behavior. Consequently, it is being used to dissipate supercooled clouds over airports. And on the basis of present knowledge, there is little doubt that thinning supercooled clouds or breaking them up could increase the amount of solar energy that reaches the earth. There is an opposite effect that could also be beneficial. By seeding the clear, supersaturated atmosphere to produce an overcast of cirrus clouds, we may be able to reduce the flow of solar energy to the earth. In the daytime this would slow down the "heat engine" that produces the convective clouds we associate with storms. At night, artificial creation of a cirrus overcast could slow down the cooling of the earth by reducing the radiation of heat back into space.

Although cloud seeding will undoubtedly remain a powerful technique, new methods are now under development and may soon increase in importance. In the light of modern scientific knowledge, there is little



doubt that, as the Roman poet Lucretius suggested, salt particles produced from the ocean play an important role in the formation of clouds and rain particles. Experiments are now under way to see what effects can be produced by releasing artificially produced salt particles into the air. These tests may lead to new techniques for changing the weather.

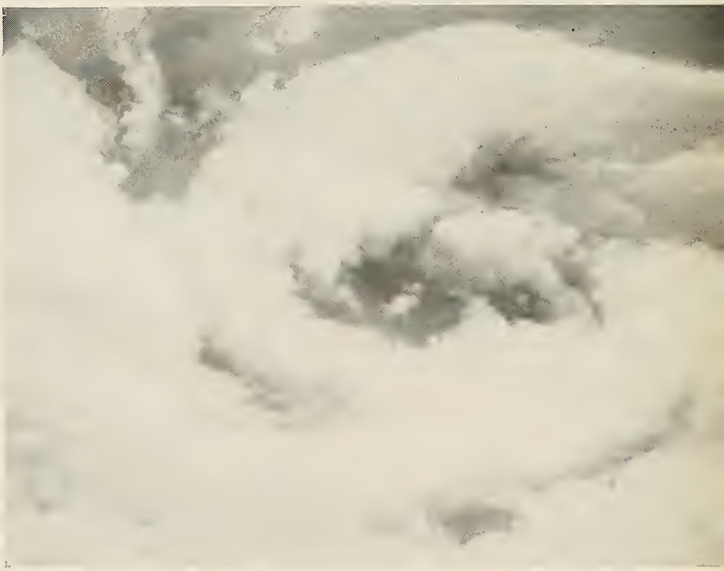
There is also an approach through electricity. This introduces the question of just what a thunderstorm is; the host of things we don't yet know about lightning; the difficulty in guessing when and where lightning will occur in an electrified cloud. A lively thunderstorm does not lend itself easily to investigation by the physicist. But from observations of such storms, from laboratory studies, and from theoretical analysis we are increasingly aware that atmospheric electricity may not be so much the product of falling rain as it is an important factor in the formation of snow and rain; and in some clouds it may even help determine the motions of the air.

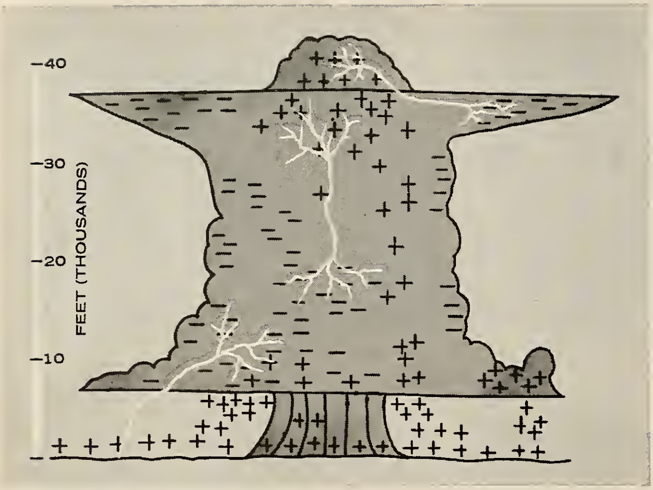
Basically, we know, of course, that the positive and negative charges in the thunderstorm reside on a variety of particles. And there is now evidence that the updrafts carry positively charged particles while the downdrafts carry negatively charged particles. In any case, observations continue to confirm Benjamin Franklin's idea that the upper part of most storms carries a preponderance of positive charges while the lower part is preponderantly negative. When enough electric charge accumulates, a process called "dielectric breakdown" occurs suddenly. The atmosphere, normally a poor conductor, suddenly provides a conducting channel. The highly luminous spark discharge formed in this ionized channel is known as lightning.

It follows no single rule. Only about 10 per cent of the lightning discharges from cloud to earth. Most lightning in the average thunderstorm is within or between clouds. A few exceptional strokes go upward from the cloud into the clear air above. Nor does it always require a thunderstorm. Lightning may occur in snow, dust, or sand storms. Lightning above the Icelandic volcano Surtsey was associated with an erup-

For safer aviation, seeding can now produce openings through layers of supercooled clouds. From left: looking down just before time of seeding with dry ice pellets; closer view 13 minutes after seeding shows early effect on the 600-foot-thick altostratus cloud deck; in next two aerial photos a useful hole is ready 26 and 34 minutes after seeding.

A typical hurricane: warm, moist air gathers speed while spiraling toward the calm "eye" at center. Besides photographing the capricious storms, aircraft are being used to seed them in hopes of taming their fury or steering them away from land.





In a thunderstorm, lightning flashes between areas of positive and negative electrical charges. The drawing gives approximate idea of where various researchers have observed such regions of charge.

tion of high-velocity steam from the crater. Lightning has also been seen to form in the clear air around an exploding nuclear device. And the U.S. Navy had an interesting surprise a few years ago when one of its cameramen photographed the result of test-dropping a depth charge into the sea. The underwater explosion sent up a plume of water that, in turn, triggered a discharge of lightning from a thundercloud brewing above.

Weather scientists hope that lightning experiments now under way will lead to techniques for artificially modifying the electrical properties of the atmosphere, thereby influencing the physical processes in clouds. For example, it is now possible, by attaching wires to a rocket and firing the rocket up into a thunderstorm, to trigger a discharge of lightning. A similar approach, dispersing small metallic needles into a cloud from an airplane, may be a way to reduce the charge of electricity in a thunderstorm. It brings the hope of reducing the energy of the tornadoes, or even breaking them up, by firing long wires into them. In effect, the wires would short-circuit the electrical charge the tornadoes generate.

Such are the hopes. But they bring questions that will need answering. What about the legal problems involved in dumping snow here or preventing rainfall there? We must also consider technical problems. By suppressing lightning we also suppress a natural agent that apparently helps a cloud's tiny water droplets coalesce into raindrops. Even the thunder may be useful. Through their expansion process the sound waves provide momentary cooling that may be as effective as artificial seeding methods.

The great scientist H. von Helmholtz summed it up nicely in 1875. "Under the same sky in which the stars pursue their orbits, as symbols of the unchangeable lawfulness of nature, we see the clouds towering, the rain pouring, and the winds changing . . . the most capricious of all processes in nature, impossible to bring inside the fence of its LAWS." This is still true. At our present level of understanding, atmospheric behavior fluctuates so erratically, with droughts, floods, and unpredictable extremes of temperature, that it is continually anomalous, and if we do produce a major change in the weather, it is doubtful whether we would be able to recognize it as man-made. But if it is not yet certain that man can modify the weather according to plan, the fact is that he has been doing so unintentionally for quite a while, and with important effects on his environment.

The planting of crops and grazing have replaced vast forested areas with fields and treeless plains. These absorb and emit radiation quite differently; they retain and give up moisture differently. When we strip vast areas of land of their natural vegetation, as we have learned to our sorrow, the dried earth may blow off in the form of dust storms that can cross an entire continent and significantly reduce the solar radiation that reaches the earth. We know that raindrops and snowflakes usually form on the atmospheric dust particles, so the dust storms must appreciably affect the precipitation process. Also, the electrical charges generated by blowing dust can sometimes become large enough to cause lightning. If on a large scale, the effects may very well alter the weather.

Another inadvertent influence on weather is man-made air pollution. Even without scientific instruments it is plain to see that smoke and smog can appreciably reduce the solar radiation that reaches heavily populated areas. Instruments reveal other effects. For example, air pollution often increases the particle population of the atmosphere from perhaps a thousand particles to more than a hundred thousand particles per cubic centimeter. Measurements show that the advent of the nuclear age has produced significant changes on the atmospheric electrical variables.

Then, too, there is the discovery, with possible important implications, that the vapor and the automobile exhaust from most gasolines, when reacted with minute traces of iodine, will generate enormous numbers of very effective ice-forming nuclei, probably lead iodide. It may also be that at times the atmosphere naturally contains enough iodine to produce large-scale cloud seeding, with a corresponding effect on weather.

Because we cannot put our finger on the exact weather changes produced by our activities is no reason to doubt that such changes have occurred—it is almost inconceivable ıat the enormous amount of gases ıd particles we pour into the atmoshere should be without effect. The ifficulty is learning enough about ıe atmospheric behavior to make a ɛasonable estimate of how imporınt the man-made changes are.

This is why, although adequate ıols are certainly necessary for eather control, they will not be all e need. From practically all of our ҫperience in controlling things—an ırplane, for example—we know that ¡uipment for modifying behavior ɛquivalent to the plane's throttle or ɔntrol surfaces) is not enough; we so require instruments to tell us in ɛtail what and how we are doing. ven the best-designed plane would ɛ a completely futile and dangerous ɛvice if the pilot couldn't tell where ɛ is and in what direction and how ıst he is proceeding—a situation ɔmparable to our present fragmenıry, incomplete picture of what is ɔccurring in the atmosphere. Connuing the analogy, an effective techique of weather control will unɔubtedly require an elaborate sysm that tells us minute by minute, ıd in detail, what the many variɔles in the atmosphere are doing ıd how our activities are affecting ıem. In the long run, the problems f weather control will be inseparɔle from the problems of observing, easuring, understanding, and preicting the behavior of the giant heat ıgine we call the atmosphere.

There is good reason to believe ıat we not only can modify its beavior but that we have been doing ɔ for some time, probably on a ırge scale.

Meanwhile, we are making a small, ıt real, beginning. We are dissipatıg supercooled fogs over airports; ʋidence is coming in that indicates e are successfully increasing precipitation in some areas and in others ɛducing the damaging effects of ıil. The complexities of going furıer are so vast that it seems likely rogress will come by small steps, not y giant breakthroughs.

his started as a depth charge ɛst. But the erupting water in turn iggered a discharge of lightning ɔom a thundercloud brewing above.

SKY REPORTER

This fall, for the first time, earthbound scientists, with an electronic assist, got their hands on an actual sample of the moon. Surveyor 5 lowered a six-inch black box on a string to the lunar surface. A radioactive material inside the box emitted charged particles. Instruments inside the box measured the energy of the particles, which bounced back after striking the nuclei of the surface elements. The findings? In at least that part of the Sea of Tranquillity where Surveyor landed, the moon is composed of the same materials as the earth—basaltic soil and rock of volcanic origin.

After preliminary analysis it was announced that the moon certainly has been hot with volcanic activity in the past and probably still is. The heat for the volcanic activity could come from the decay of radioactive materials, gravitational compression, and the tides set up on the moon's surface by the earth.

EMPTY SPACE

Evidence is mounting that not only is the earth plowing through a cloud of dust that envelops the sun but it is also carrying its own even more concentrated cloud of dust along with it.

Estimates of the amount of dust in interplanetary space have been made for some years from observations of the zodiacal light, a luminous band that stretches along the ecliptic from the point where the sun is under the horizon at sunset or sunrise. This light is caused by the reflection of sunlight from the dust particles.

Satellites have found the concentration of dust near the earth to be several times that of the earlier estimates based on the zodiacal light.

The particles are small, measured in thousandths of an inch, but are numerous enough to add up to a large mass. Studies of only the metallic dust from space found in the ocean-floor ooze and in Antarctic and Greenland snow indicate the amount of cosmic dust added to the earth each year is on the order of 100,000 tons.

Our present knowledge of the dust was reviewed in a recent issue of the journal *Soviet Astronomy* by N. B. Divari of the Odessa Polytechnic Institute.

Divari says that one of the important questions concerning cosmic dust is where it comes from. He points out that there must be a constantly replenished supply, because dust particles coming too close to the sun are vaporized. Comets might be a major source of dust. Or, do colliding asteroids furnish the larger portion?

The question of where the dust supply comes from remains unanswered, he says, as does the question of how the earth acquired its more concentrated cloud. Meteoroid collisions near the earth may supply some of the dust: there is evidence that the concentration level rises when the earth passes through a meteor stream.

Divari argues, however, that neither meteors nor simple gravitational capture alone can account for the earth's cloud. Some of the dust may have originated on the moon, he suggests.

Whatever the answers, the evidence is mounting tha the "empty space" above the earth's atmosphere is any thing but empty. A better understanding of the dust an its origins may lead in turn to an understanding of th origin of the solar system itself.

John P. Wiley, J

CELESTIAL EVENTS

The sun arrives at the winter solstice, its most southe ly position in the sky above earth, on December 2 at 8:17 A.M., EST, marking the beginning of winter i the Northern Hemisphere. On that day also the su crosses the sky on its lowest path and spends the shortes time above the horizon—for observers north of th Equator, that is—resulting in the shortest day and th longest night of the year.

The 22nd is not, curiously, the date of the latest su rise and the earliest sunset, as can be seen from the cha at the bottom of the opposite page. The earliest suns occurs on December 8; the latest sunrise comes on Ja uary 4. How, then, can the 22nd be the shortest day the year? Actually, if you time the total interval fro the moment of sunrise to the moment of sunset, it i But the times of sunrise and sunset are usually given i local mean time, a uniform system not subject to th irregularity of local apparent time, which depends stric ly on the sun's daily motion.

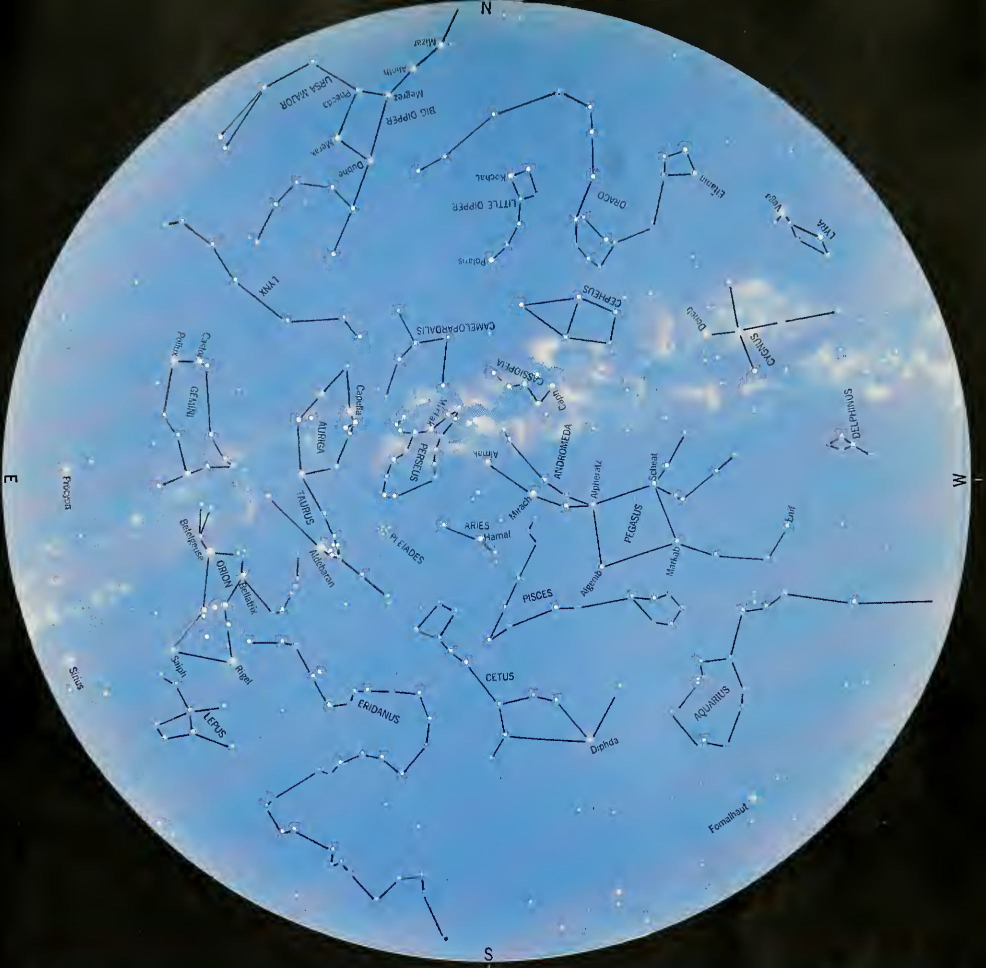
The morning sky, in December, still boasts the brigh est planets, Venus and Jupiter. Venus is getting faint and appears lower at dawn each morning, as it mov farther away from earth, but it is still brilliant an prominent in the east before sunrise. Jupiter now ris somewhat north of east before midnight and moves in the southwest by daybreak. It begins its retrogra (westerly) motion among the stars of Leo on the 22n

Mars still hangs low in the southwest in the ear evening sky, but sets soon after. Saturn is in the sou (to the left of the gibbous moon on the 9th, to the rig on the 10th) at sunset and sets shortly after midnigh

The brightness of the moon will interfere with th observation of two meteor showers that reach the maximum intensity during December—the Geminids o the 13th and the Ursids on the 23rd. The Gemini should be the more rewarding of the two to watch.

Thomas D. Nicholso

Hold the star map so the compass direction you face is the bottom; then match the lower stars with those in th sky near the horizon. The celestial events chart shows tim of rising and setting of the sun, moon, and principal pla ets; times of twilight; and sundial correction during th month. The horizontal scale shows time; vertical sca shows dates. The top strip locates bright stars, planets, a the moon within the zodiac. The horizontal scale of hou shows the time when planets and certain stars are due sou and highest at midmonth. The different phases of the mo shown are due south and highest on the dates indicate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CAMELOPARDALIS
CASSIOPEIA
Caph
Castor
Pollux
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Capella
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ANDROMEDA
Alpheratz
Scheat
DELPHINUS
Procyon
TAURUS
ARIES
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Mirach
PEGASUS
Enif
Betelgeuse
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Aldebaran
PLEIADES
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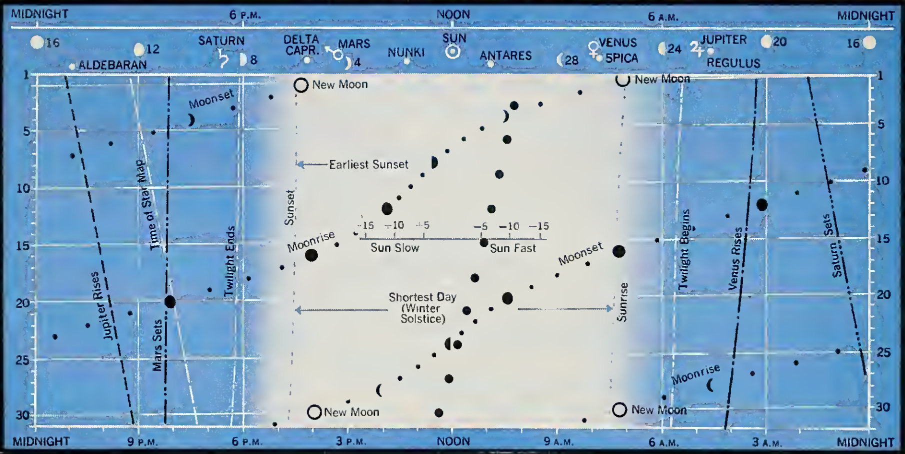
MIDNIGHT
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VENUS
SPICA
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JUPITER
REGULUS
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ALDEBARAN
New Moon
New Moon
Moonset
Earliest Sunset
Sunset
Moonrise
Sun Slow
Sun Fast
-15
-10
-5
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-10
-15
Moonset
Shortest Day (Winter Solstice)
Sunrise
Time of Star Map
Twilight Ends
Jupiter Rises
Mars Sets
Twilight Begins
Venus Rises
Saturn Sets
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MIDNIGHT

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The Art and Technique of Eliot Porter

Continued from page 31

that distracts from the composition. When you look at your subject with one eye everything seems to fall into this two-dimensional relationship.

Q. I've noticed that in your photographs you do something other photographers rarely do. With confused subjects, with a foreground and a background, you make both of them sharp, yet perfectly meshed. You have some very intricate photographs of some yellow leaves in a brown tree with a landscape in the background (*see page 28*). The tree covers the full format or nearly so; the background is also all over the picture, filling the format. Most photographers would try to throw the background out of focus and photograph the tree or have the tree out of focus in the foreground, punctuating the over-all background landscape with out-of-focus shapes. It would never occur to them to hold both tree and background sharp and make them mesh perfectly, as you have done. In your picture the background is seen through the foreground, instead of having the foreground at the top or bottom of the picture, with the background taking up the rest of the picture. Both foreground and background cover the full format.

Porter: I think this is simply the way I see everything. I must see it this way. People often say that you don't see things all in focus at once. Actually, if you could arrest the focusing mechanism of a person's eye, you would then put him in the position of a camera that was focused only on part of a subject, foreground or background. But we have an ability to refocus our vision from foreground to background so rapidly that we have the impression that everything is in focus at once. That's the way I see a landscape, with everything in focus at once. Actually, it has something to do with what interests me in pictures. I don't think about this consciously. It's just a matter of the way I see things and subconsciously work. A pattern or a very intricate scene in a woods or in brushland, where there is a great deal of vegetation, can often be organized into a vignette of the over-all scene. A piece of it can be taken out, and if the proper piece is taken, it can be a satisfactory picture that has a unity of its own. But there are pictures with certain features that I don't like. One thing I don't like in pictures, and which I try to avoid, is having a very light object in the lower foreground, a white stone or leaves or something. It seems to me the wrong place for a highlight. If that's what the subject contains, I try to select a point of view that takes in either something below the light object, so there's a dark strip at the bottom of the picture, or I eliminate the light thing entirely by moving to another place, so I can have some other aspect of the background that doesn't have this object in the foreground. Sometimes, with complicated compositions, it adds to the interest of the composition if there is a little confusion about what plane an object is in. There is one picture in "*In Wildness*" like that—some dark trunks and some white birch trunks. You can't tell at first glance which trunks are in front and which trunks are in back. This would never occur if you had binocular vision or with stereoscopic pictures. It only occurs because the camera has one eye, and when you look at the camera version on a piece of paper the three-dimensional quality has been lost.

Q. Does this have anything to do with the compositional convention of lighter tones being in the background?

Porter: Not necessarily so, but with aerial perspective, as with distant mountain ranges, it does. That's the way it appears in nature, because of haze. I think a picture is more interesting when there is a doubt in the viewer's mind as to exactly what the situation is. Not always, because you don't want to confuse the viewers, the audience, or cause trouble for them. If you cause them too much trouble, they won't look at the picture. If it's just a mess, they'll reject it. But if there's just enough doubt, it stimulates them to look at it longer. And I think that's why a picture with a very complicated set of objects in it is sometimes more fun to look at than one that is very simple. When I say that I don't mean that I reject simple pictures, because I also like pictures

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that are simple too. In some ways I think pictures that are extremely simple and that are at the same time well conceived are perhaps the best of all pictures. They're also the hardest to do. It's hard to take a simple, dramatic picture and have it really contain something that has lasting interest. If you can do that you have really achieved something. It's almost like Chinese painting. You've got things down to their elements. And my pictures—my intricate subjects—would be far from that.

Q. But you do take photographs that are very simple indeed. The one taken in the Adirondacks of the black bush and tan grass in the snow, for instance [which is on the cover of this magazine]. It is all in line, no form, no big masses, except the implied form made by the lines of bush and grass.

Porter: I like that picture, I liked taking that picture. I just suddenly saw it. But a lot of the pictures I took in the Adirondacks were far from simple. They're fun to take. You can juggle things around until you find just the right place, with everything arranged so that when you look at the finished product there is no tendency for your eye to wander out of the picture, which would be the case if you felt there was something missing. On looking at a photograph or a painting or any kind of graphic art, if your eye isn't trapped by what you see, and you start to look for something that isn't in the picture, the picture isn't a success.

Q. Do you have any favorite kind of lighting?

Porter: I don't know as I do. I think morning and evening light conventionally is more interesting than noon, certainly in landscape photography it is. But you sometimes get good crosslighting and good modeling of shadows even at noontime.

Q. But many of your photographs seem to have been taken on heavily overcast days or in complete shade.

Porter: Sometimes I think those conditions are much better. Sometimes bright sunlight makes the subject far too spotty, with deep shadows and brightly lighted areas. The color, perhaps, is more saturated, but you lose a sense of the form and structure and texture of what you're look-

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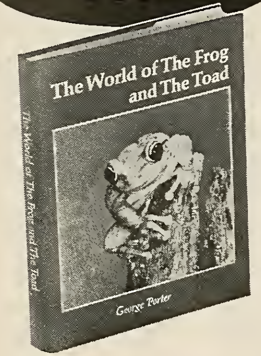

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ing at, which is quite contrary to what some people feel, I think. It is generally believed that crosslighting gives you much better rendition of texture. Maybe it isn't texture that I'm talking about, maybe it's sort of the nature of the subject matter. For instance, if you're photographing a rock with lichen on it, it's better to do it on an overcast day or in the shade, not in bright sunlight—it comes out more like a lichen on a rock.

Q. Who has most influenced your work? Which photographers, writers, painters, and musicians, if any?

Porter: Let me start out with photographers. Alfred Stieglitz influenced me very much of course. But before Stieglitz, Ansel Adams' photographs influenced me more than anything else. Seeing his pictures, which was before I even went to see Stieglitz, was an eye-opener to me as to what could be done with a camera, with photographs in every respect—in subject matter and seeing, as well as in print quality. It was a revelation. So probably Ansel Adams comes first and Stieglitz second. After that there are many photographers whose work has influenced me, I suppose—Rothstein, Lange, Evans. As far as writers go, the nature writers—Aldo Leopold, Joseph Wood Krutch, Loren Eiseley, Marston Bates, Archie Carr, Jack Tomlinson—have influenced me.

Q. Have you been accompanied by your family on any of your jaunts?

Porter: My wife accompanied me to Greece and to Mexico. She hasn't gone with me on my nature trips because she is a painter and she doesn't know what she would do while I'm off taking photographs all day long. She would feel out of place, since she doesn't paint landscapes, but still lifes. I've taken my children on trips. And I suspect they usually found it rather boring.

Q. Was that after they were fairly grown up?

Porter: No, I've taken them when they were as young as eight. I've gone ahead and photographed, and they didn't know anything else, so they just accepted it. I went to Yellowstone once with two of them, and I think they enjoyed that very much. They loved seeing the bears. They enjoyed the geysers and the campgrounds where we stayed. ■

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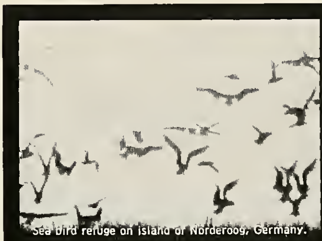
Sea bird refuge on island of Norderoog, Germany.

Guanaco, South American humpless camel, Patagonia.

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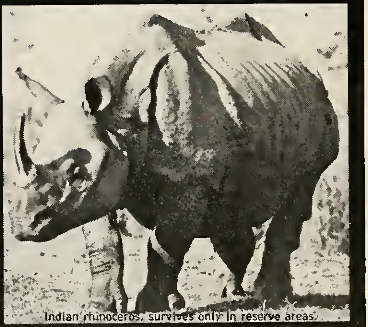
Grevy's zebra, Africa.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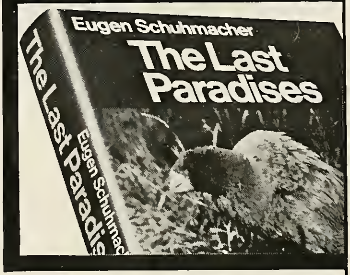

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From the Primeval to the Paved

by William O. Douglas

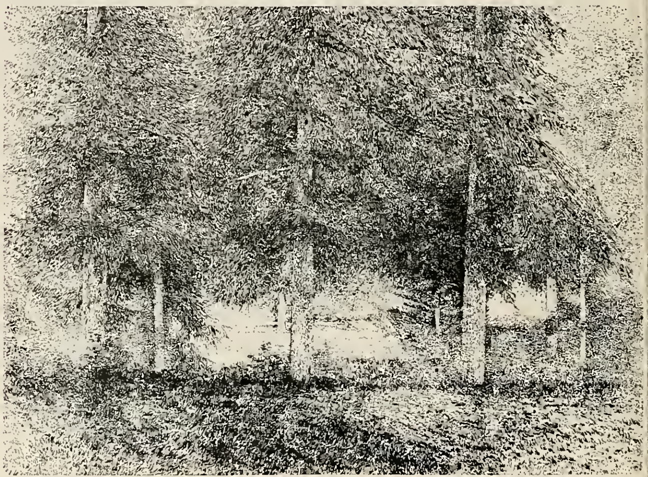
Wilderness and the American Mind, by Roderick Nash. *Yale University Press, $6.50; 256 pp.*

This book is a mandatory prelude to any modern treatment of conservation problems. It does not purport to tell us where we go from here. But it reports in telling fashion how we got where we are and the nature of the forces that have driven us pell-mell toward a leveling of the wilderness. Public attitudes do determine public policies, and these attitudes, which we have obtained from Sunday school and public school and folklore, persist as powerful imponderables on which public relations men for commercial interests build their campaigns for continuous invasion of wilderness tracts and ceaseless exploitation of the few areas of wildness that we have left.

The word wilderness has many shades of meaning. In the Old Testament, wilderness is largely a piece of wasteland. Today it means different things to different people, apart from its many figurative uses, as in connection with the megalopolis. The apartment dweller in a trailer in a national park thinks he is in the wilderness. A piece of forest may be wilderness to an urbanite. To others any inhospitable or mysterious area is wilderness. A valley with a road is not considered wilderness by some. By the act of 1964 a wilderness must be of a certain size and in untrammeled or primitive condition. And so the definition changes, depending on the individual and his interests. As the author says, the concept is that of a spectrum that runs "from the primeval to the paved."

The multiplicity of the definitions of wilderness reflects the wide variety of views concerning it. And that is the thrust of the book: a search through the literature of the Western world for attitudes toward the wilderness and the various philosophies concerning it—century by century, school of thought by school of thought—and what people, particularly we Americans, have done about it.

By our Christian philosophy, leveling the wilderness became almost a sacred rite, for it represented forces of evil where savages, wild beasts, and spirits, all dangerous to Christian man, dwelt. The destruction of the wilderness and



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Discoveries of the last decade are confirming Darwin's famous speculation about the importance of the prehistory of Africa and its role in the origin of man, the development of animals and plants, and the changes in land areas. This book surveys the new evidence gathered in Africa by palaeontologists, geologists, archaeologists and other scholars — including Dr. L. S. B. Leakey who describes his much-discussed mammalian finds from Miocene and Pleistocene East Africa. A bilingual book, the English papers are preceded by French abstracts, and vice-versa. The editors are, respectively, lecturer in geology at Bedford College, University of London, and Professor of Anthropology at University of California in Berkeley. $27.50

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its life became a good deed. for this philosophy considers man to be *above* all other forms of life. Was not St. Francis denounced as a heretic for considering man as a member of a vast community who should show reverence to the other members, be they birds or plants? Certainly the Puritans came to these shores with those attitudes; much of the settling of the lands to the west of New England was done in this spirit. Yet our people were not always unanimous even on the wilderness issue, and voices began to be heard that found values in wilderness other than trees to convert into lumber, streams into power and navigation, and valleys into cities. The author has retrieved from a largely lost stream of American thought many of these schools of thought.

The great turning point in American thinking was certainly led by Thoreau, though it came years later, and the maturation of our appreciation of wilderness values arrived with Muir and Leopold. There were many who put the ideas of those men into specific programs of action, as the consciousness of values other than dollars increased and as the Puritan influence waned. Whether the majority of our people are anywhere near abreast of Thoreau, Muir, and Leopold is doubtful. But the conviction that wildness holds the key to preservation has become a powerful force in the affairs of state, as evidenced by the Wilderness Act of 1964 and the so far successful efforts to save the Grand Canyon from dams.

The book, in addition to tracing the evolution of the attitudes of the Western world, treats the highlights of American efforts to establish parks, forest preserves, and the like. It credits Pinchot, Bob Marshall, Howard Zahniser, Sigurd Olson, and others for heroic work. It also covers a few lost causes, such as Hetch Hetchy. And it has one sentence at the end respecting the threat of population pressures to the small segments of wilderness that we have left.

The book, in other words, bypasses the critical burning issues of today and tomorrow.

The contemporary forces of destruction are like ten thousand or more scattered brush fires. One town is trying to save from subdivision thirteen acres of forest in its midst. Another is trying to keep a river by its front door safe from upstream sewage. A local group is trying to prevent a road being extended one mile into a heartland of wilderness so that big trees can be cut. A pond in New Jersey, a lake in Nevada, a river in Washington, are doomed by engineers and real estate developers. The National Park System is bent on carving up its inner sanctuaries so that

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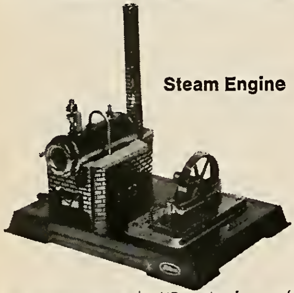

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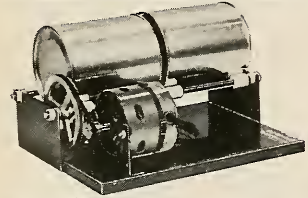

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This is the kind of stuff out of which the present-day skirmishes are made. Are all alpine meadows to be filled with Hilton hotels?

Have we reached the point where the Willamette River in Oregon or the Missouri farther east is to be considered essentially as a carrier of sewage and industrial waste?

How far are roads and pavements to reach?

Are there to be refuges for some of our wildlife but none for man?

If there are to be refuges, how large should they be to meet the population pressures?

Primeval forests are mostly gone. Can cutover, mutilated land be reclaimed and restored in time for man's varied recreational needs?

The book is not an impassioned plea one way or the other. The author, so far as one can tell from the text, might be just as happy if all alpine meadows were motel, cocktail, and dance hall concessions. He does not take sides. There is a suggestion at the end that the pressure of people on wilderness may be as devastating as the activities of commercial interests. Those who financed the project that resulted in Mr. Nash's work may be, like the CIA, forces of erosion and apologia. But the book has integrity; those who read with discerning eyes will have a measure of the forces that the Establishment can muster to destroy us.

William O. Douglas, Associate Justice of the Supreme Court, is an ardent conservationist and author of the book "A Wilderness Bill of Rights."

THE GYPSIES, by Jan Yoors. *Simon and Schuster, $5.95; 256 pp.*

An intensely personal book, *The Gypsies* either captures the wholehearted sympathy of the reader or leaves him incredulous and bored. There are those who will live, with Jan Yoors, his childhood among these mercurial people, and who will understand, feel, and love with him. Others will be frankly disbelieving, unperceiving, and unfeeling. For the latter I am sorry, for even if the whole thing were an invention, which I do not for a moment believe, I would still recommend the book in similar terms, for the perception and the feelings are real and teach us much about ourselves as well as about our fellow beings. Above all they teach us about the Gypsies, and this nobody with the least knowledge of gypsy life could deny.

The author himself was not gypsy born, but as a child joined a gypsy band and wandered through Europe

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ith the Rom, learning their language nd their thoughts and beliefs. In decribing the wanderings of the family hat adopted him, Jan Yoors evokes the mood he set out to evoke, with a charm nd tenderness that are part of gypsy ife itself. The sequence of events is ften disjointed, with an occasional hiaus, as when the wandering child is reurned reluctantly to his parents and he scene shifts from the wild freedom f a gypsy camp to the constrained ounds of a Belgian drawing room.

Mr. Yoors gives many hard and valuble facts about gypsy organization, which corresponds significantly to he organization of other hunting and athering peoples throughout the world. The scale and scope of operaions are somewhat different, but that s all. Instead of hunting on foot, in the ustralian deserts or the Congo forests, he Gypsies, it seems, may do their unting by cruising up and down Fifth venue in a Cadillac convertible. Mr. Yoors deals more with the conventional aravan than the Cadillac, but the later need not be as unromantic as it eems. Even in such an unexpected conext the Gypsy is still the same at heart, nd treats all *gaje*, or outsiders, with he same shrewd political acumen. Whether they are dealing with the New York City police, or with the irate burghers of some rural European townhip, the Rom use the same tactics, seure in the inner knowledge of their own superiority as human beings, conemptuous of the attempt to subject hem to a law that is contrary to their own, indignant and resentful of the humiliation to which they are submited by a people superior only in terms of physical force.

At a time when there has never been greater need for understanding of other ways of life, *The Gypsies* has a special value. It may be too much to hope that he book will alleviate the lot of these trange, scattered wanderers, but if it helps a few people to find something of hemselves in others apparently so diferent, it will have achieved much.

COLIN M. TURNBULL
The American Museum

MY FRIENDS THE WILD CHIMPANZEES, by Jane van Lawick-Goodall. *National Geographic Society, $4.25; 204 pp., illus.*

It did not seem possible, but the National Geographic Society has exceeded itself. The society, well known for the excellence of its photographic displays, has combined this excellence with an ingenuous and charming story written by a young woman who spent lmost seven years observing chimpanees in the Gombe Stream Game Reerve in Tanzania, Africa. The result is

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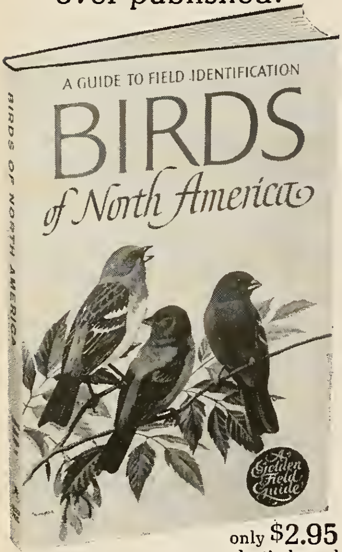

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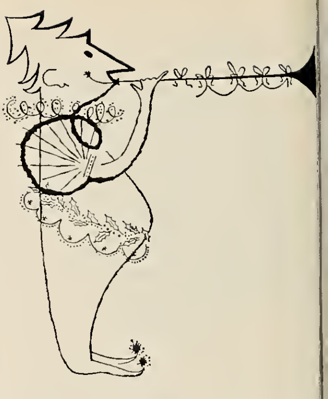
My Friends the Wild Chimpanzees by Jane van Lawick-Goodall, with photographs by her husband, Baron Hugo van Lawick.

Jane's account (for some reason it seems appropriate to use her first name) is one to inspire admiration. Initially set back by fever, she showed audacity and courage by living in the midst of these powerful and unpredictable wild animals. She kept tenaciously at her task until she achieved her goal, a long-term study of how chimpanzees live in their home environment. Although at first the chimpanzees fled at the sight of her, she remained undaunted. A real breakthrough came inadvertently through the action of David Greybeard, one of the fiercer animals. David approached and snatched Jane's lunch banana one afternoon; from that time onward the camp made bananas available to the chimpanzees, which soon learned to visit regularly. The establishment of this feeding area in the midst of chimpanzee country permitted Jane to make many more observations than would have been possible if she were forced to find the animals fortuitously.

Her observations mainly cover family structure and social interactions, such as male-male, male-female, female-female, mother-infant. Chimpanzees spend most of the day searching for food, and a great deal of their recorded behavior is concerned with feeding activities. Some of the most striking observations are of behavior that is not widely known, for example, the flamboyant and frightening rain dances carried out by the males, the catching and eating of monkeys and baboons (chimps were thought to be essentially vegetarians), and particularly, the making and using of tools to dig termites out of their nests. The chimpanzees alter long grasses into "fishing rods," insert these rods into termite mounds, and withdraw them with termites clinging to the tips. Young apes learn how to make these modified rods by the time they are three (they reach adolescence at seven). I was fascinated with this tool-fashioning technique and I wondered how it came about during the evolutionary history of the chimpanzees, that is, how did the animals first come upon the method? I wish that Baroness van Lawick-Goodall described more about how the young learned to make and use these tools. Perhaps as she continues her observations she will be able to report in greater detail on this subject. The rain dance is a frenzied and wild stomping apparently related to sudden downpours, thunder, and lightning. It is curious that these advanced animals do not seek shelter when it rains. Instead, they sit in tree branches and



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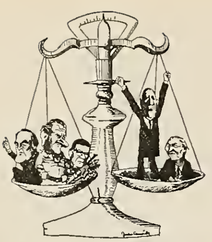

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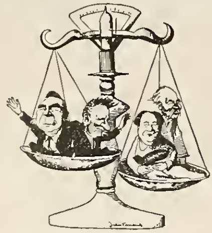

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moan, evidently uncomfortable, and evidently getting soaked. However, the mothers do envelop the young and protect them from the rain. There is a long description of the eating of a baboon and of the social interplay that takes place among the apes when this baboon is being consumed. In addition to the many behavioral observations, Jane describes her personal adventures and misadventures. There are a few minor points that I found objectionable, such as using the word "stealing" when referring to an action by a chimpanzee and several other details of interpretation, but they do not mar the general high quality of the book with its especially outstanding photographs. The color plates are magnificent, large, and abundant. They are probably the finest collection of chimpanzee portraits to be found. The subjects are full of whimsy and charm, and many readers will find the young chimpanzees most engaging. There is an excellent photographic series on the range and diversity of facial expressions, on grooming activities, on baboons with chimpanzees, and on gesturing behavior used in different social situations.

It is a book that I can unreservedly recommend to all readers.

Evelyn Shaw
The American Museum

Wings in the Meadow, by Jo Brewer. *Houghton Mifflin Co., $4.95; 187 pp., illus.*

This is an unusual book, written by an uncommon person: a non-professional with boundless enthusiasm, a gift for communication, and a respect for science. It is written as fiction, in somewhat the manner of Rachel Carson's *Under the Sea Wind*. That is, particular animals (in this case monarch butterflies) are individualized and are followed through their travails and their moments of glory. There is also a human, Mr. Stevens, who owns the meadow and is rewarded and refreshed by the activities of its denizens. The result is a book that holds one's attention as a straight account of life history data would never do. There is drama, suspense, and a generous dash of poetry, all of it greatly enhanced by Henry B. Kane's excellent drawings. There have been other books on the monarch butterfly, but none that are likely to have the wide appeal of Jo Brewer's *Wings in the Meadow*.

Mrs. Brewer is an amateur lepidopterist who writes for those outside the circle of academic biology; yet there is little here that is likely to offend the professional. I did find myself inclined to pencil a question mark in the margin here and there, but in the final analysis these did not add up to much. Professional biologists need to face up to

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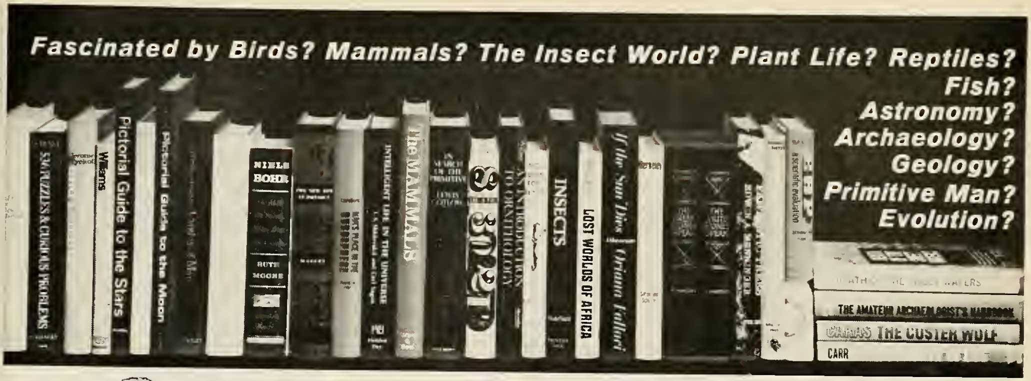
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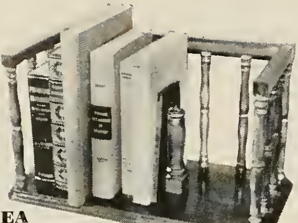

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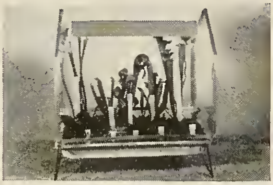

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the fact that they almost never succeed in communicating with persons that have little or no biological training (and this, unfortunately, includes practically everyone). As we continue to ask ever more profound questions of nature, we are going to need articulate middlemen if we hope to keep the public informed. Is there any point in asking the questions if we intend to keep the answers to ourselves?

Howard E. Evans
Museum of Comparative Zoology

Red Giants and White Dwarfs, by Robert Jastrow. *Harper & Row, $5.95; 176 pp., illus.*

The content of this misleadingly titled book is more aptly described in the subtitle: *The Evolution of Stars, Planets and Life.* It is probably the most successful account yet published for the layman of the continuous thread of events that led from the beginnings of the universe to the appearance of man on this planet. Physics, chemistry, biology—all these aspects of this beautiful story of creation are explained so clearly that one needs no particular background in any of them to follow what might, in less capable hands, be baffling. Jastrow, who honed his explanatory skills on the CBS network's "Sunrise Semester" in 1964, is Director of the Goddard Institute of Space Studies. His book, which is skillfully illustrated as well, can, should, and probably will be read by many people in one sitting.

J. K. P., Jr.

PAPERBACKS

Travels and Traditions of Waterfowl, by H. Albert Hochbaum. University of Minnesota Press, $2.95; 301 pp., illus.

The Fishes, by Url Lanham. Columbia University Press, $2.25; 116 pp., illus.

The Insects, by Url Lanham. Columbia University Press, $2.95; 292 pp., illus.

Song Birds of the World, by Oliver L. Austin, Jr. Golden Press, $2.95; 318 pp., illus.

Water and Marsh Birds of the World, by Oliver L. Austin, Jr. Golden Press, $2.45; 223 pp., illus.

The Rat, by S. A. Barnett. Aldine Publishing Co., $2.95; 288 pp., illus.

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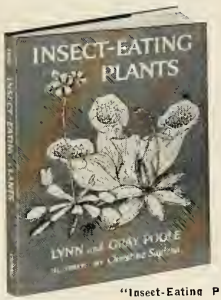

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Valiant Crusade. A. W. Moss. Cassell & Co., Ltd., London, 1961.

Both Small and Great Beasts. R. Hill. The Universities Federation for Animal Welfare, London. 1964.

All Heaven in a Rage. E. S. Turner. Michael Joseph, London, 1964.

PLEISTOCENE OVERKILL

Pleistocene Extinctions: Search for a Cause. P. S. Martin and H. E. Wright, eds. Yale University Press, New Haven, 1967.

Elephant-hunting in North America. C. V. Haynes, Jr. *Scientific American*, June, 1966.

LIVING DOORS

Ants: Their Structure, Development and Behavior. W. M. Wheeler. Columbia University Press, New York, 1910.

Studies on the Habits and Distribution of Cryptocerus Texanus Santschi. W. S. Creighton and R. E. Gregg. *Psyche*, Journal of the Cambridge Entomological Society, Vol. 61, No. 2, 1954.

EASTER ISLAND

Easter Island, A Stone Age Civilization of the Pacific. A. Métraux. London, 1957.

Ethnology of Easter Island. A. Métraux. Bishop Museum Bulletin No. 160, Honolulu, 1940.

Archaeology of Easter Island. T. Heyerdahl and E. N. Ferdon, eds. Monographs of the School of American Research and the Museum of New Mexico, No. 24, Pt. 1, 1961.

WHEN WILL WE CHANGE THE WEATHER?

Watching for the Wind. J. G. Edinger. Doubleday & Co., New York, 1967.

The Physics of Clouds. B. J. Mason. Clarendon Press, Oxford, 1957.

Weather and Climate Modification: Problems and Prospects, Vols. I and II. National Academy of Sciences, National Research Council, Publication 1350, Washington, D.C., 1966.

Weather and Climate Modification. D. L. Gilman, J. R. Hibbs, and P. L. Laskin. A Report to the Chief, United States Weather Bureau, U. S. Department of Commerce, July 10, 1965.

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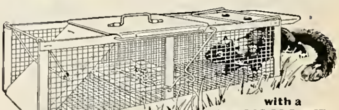

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Letters to the Editor

On Hippies

. . . This weird phenomenon, i.e., the "Hippies," is neither Natural nor History, but rather an aberration, sprung up overnight like a toadstool. . . .

Is this any way to run a science magazine?

BENJAMIN F. MIESSNER
Miami Shores, Florida

I enjoyed Professor Lettvin's article in your October issue. It was a fine piece of craftsmanship, if not a work of art, and must certainly have brought its author some of "that transcendental kick you get out of doing something well." Let me congratulate you, also, on your editorial courage and good judgment in stretching conventional definitions of natural history to include some of what is transpiring about us in the human environment.

Having searched the halls of the Pentagon and other likely watering places in vain for years, I know that there is no such creature as the modern historian. Perhaps, as other species than man vanish, the gap will in time be filled by the natural historian.

THOMAS E. PHIPPS
McLean, Virginia

NATURAL HISTORY arrived this morning and I have just finished reading your "You Can't Even Step in the Same River Once." My heartfelt thanks!

You have precisely and poetically spoken for us and, I am sure, for countless parents who battle the moth–flame relationship which hippiedom and the psychedelic syndrome hold for our sensitive, intelligent children. What you said, we also said, but you said it so much better! For us, fortunately, the chromosomal break came in time and a visit to Haight-Ashbury, *en famille*, clinched our argument. But I wish that every parent who has a child in college, or will have shortly, could read what you have said.

If there is some way that I could get reprints of your article, I would
furnish them to every fraternity a
sorority, dormitory and roomi
house at Indiana University wh
my husband is a professor of mic
biology.

MRS. SHERMAN MINT
Indianapolis, India

I am writing in regard to Jero
Lettvin's article on the hippies. l
me begin by saying that these "be
tiful people" are the future hope
a better, more enlightened wor
Dr. Lettvin states that they are n
interested in making a better socie
but are only involved with the
selves. Perhaps this is the soluti
since those people who are su
posedly interested in social welf
have made the world what it is
day, because their self-interest (
though perhaps unconscious) m
come to the surface as must their
sire for power.

The hippie is delving into hims
and finding the answers within, l
fore he sets out to rescue the wo
without. By being attuned to yo
self, you can become more attun
to the life about you, and only th
can you help others, unselfishly. LS
is a guide to the inner self, when us
for that purpose.

Why not put our faith in t
"flower people," whose movement
worldwide, take their hand, and a
them to show us the way? *Love*
the only answer!

EVE AUN
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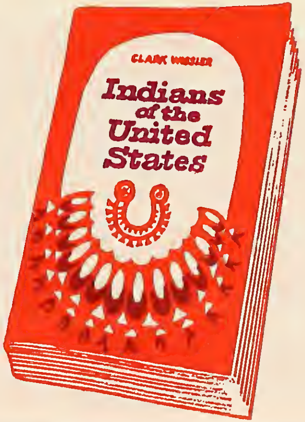
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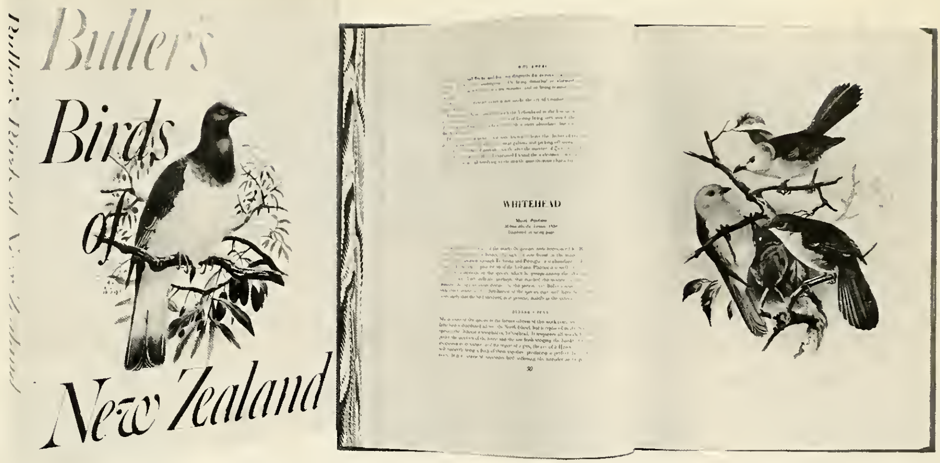

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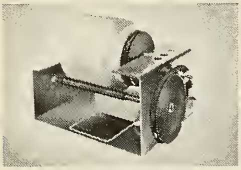

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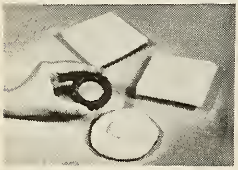

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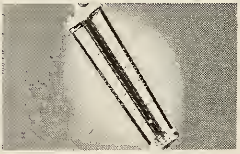

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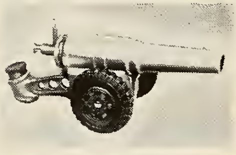

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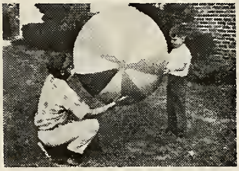

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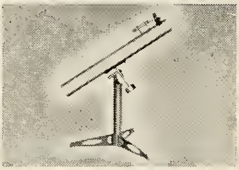

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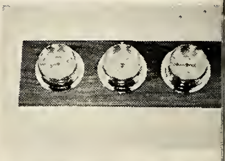

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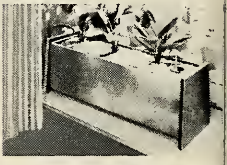

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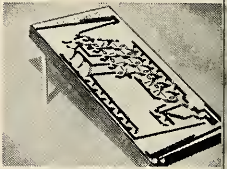

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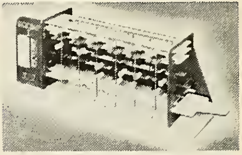

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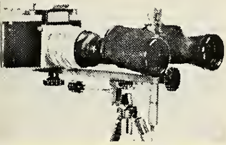

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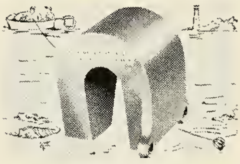

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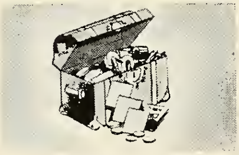

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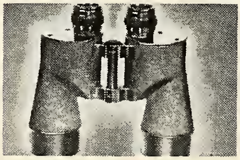

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Why Texans fought to give away their Treasure Island.

Padre Island is still giving up buried treasure from Spanish Galleons. But its real treasure is its worth as a natural recreation area, to draw visitors and vacationers from all over the country. Texans were always pretty well agreed on that. What they disagreed on was how to go about it. The Great State chose up two sides.

One side wanted free enterprise with no fences. They promised that the island, all 117 miles of it, would be developed in a sort of commercial way, and wind up like some of the large resort cities. The opposing side said no, that idea would only build an overgrown seaside amusement park. This group believed that part of the island, at least, should remain natural and undeveloped; that its big stretches of white sand, its exotic vegetation and its flourishing marine life should be preserved in its natural state for everybody, including future generations. The only way to carry out this plan was to have Padre Island made a National Seashore.

Both sides went along fairly nip and tuck until Texas' Senator Yarborough succeeded in getting Washington to agree to its part in the National Seashore. This put more fight into the opponents back in Texas, who proposed that Padre should become a State, not a National Park, leaving about half of the Island out of the plan.

But Governor Connally had promised Texas a National Seashore, and he stuck by his guns. Support rallied. A newspaper, the Corpus Christi Caller-Times, carried the cause right into South Texas, the hotbed of opposition. Largely through the work of newspaperman Ed Harte, and a committee of private citizens in Corpus Christi, the tide finally turned. Now America has a beautiful new National Seashore. The biggest yet!

Texans are proud to have you come and enjoy the near-tropic sun, the swimming, the surf-casting for man-size lunkers. You're even welcome to poke around for bits of Spanish treasure. (The fun is yours, but any treasure goes to the government!)

What's true in Texas is true all over. Officials want and need the help of private citizens like Ed Harte and his neighbors. *This is why Sinclair, which has long been dedicated to conserving natural resources, encourages people to take an active part in preserving our natural heritage.* For a booklet describing what others have done and how you can help, write Sinclair Tour Bureau, 600 Fifth Avenue, New York, N.Y. 10020. Also include your request for information about touring any scenic landmarks you may wish to visit.

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